THE

ELECTRICAL REVIEW.

VOL. LI. AUGUST 1, 1902. No. 1,288.

"ELECTRICAL REVIEW."

Vol. LI.] CONTENTS: August 1st, 1902. [No. 1,288.

	Page
The Scandal which Everybody Admits	169
Some Suggestions with Regard to Electric Motor Installations	171
Procedure on Application for Licence or Provisional Order (*concluded*)	172
The Cyclone Theory of Magnetism (*concluded*)	173
Refuse Destruction: Its Sanitary and its Steam Raising Aspects (*illustrated*) (*continued*)	174
Correspondence:—	
Fire Prevention	175
Technical Education	176
Our Legal Query Column	176
Parliamentary	177
Legal	181
Business Notes	181
James Swinburne (*illustrated*)	187
The Electric Tramway System of Newcastle-on-Tyne (*illus.*) (*concluded*)	188
City Notes	195
Traffic Receipts	198
Stocks and Shares	198
Share List of Electrical Companies	199
Market Quotations	200
Electric Baths for North Staffordshire Infirmary (*illustrated*)	201
Limits and Limit Gauges (*illustrated*)	202
Electricity for Motive Power	203
Some Details of Direct-Connected Generator Sets	203
Gas Power Statistics	205
The Reduction of Alumina by Means of Carbon	205
The Effect of Electric Waves on the Human Brain	206
L.C.C. Electric Tramways...	207
Abstracts of Published Specifications	208

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone No. 963 Holbor.

All Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to H. ALABASTER, 4, Ludgate Hill, E.C.

THE SCANDAL WHICH EVERYBODY ADMITS.

THE Urban District Council of Tonbridge offer a prize for competition by electrical engineers, the result of which will be awaited with interest. They require the services of a fully qualified electrical engineer, who must have had experience with the low pressure three-wire direct-current system, high-speed engines, accumulators, and triple-concentric cables. He will be under the direction of the Electric Lighting Committee of the Electricity Supply Undertaking, and the administrative departments connected therewith, a body of gentlemen who do not claim any special knowledge of the highly technical business they assume to direct.

Of course, he must thoroughly understand how to run the station successfully, and this necessarily involves a sound knowledge of both mechanical and electrical engineering.

As competitors are required to send in copies of three recent testimonials, thorough efficiency is evidently demanded, involving theoretical and practical training and experience during some years in the school, manufactory, and electric supply works.

Thus equipped at the cost of a good round sum in school fees and premiums, besides devoting his youthful energies to study and service, he is fitted for the prize, viz., the position of electrical engineer to the Urban District Council of Tonbridge *at the munificent salary of £150 per annum*, or very nearly £3 per week, of course without board and lodging, and minus the provision of a uniform gratis, which a middle-class family provides annually for its footman.

What a splendid prospect for the young engineer after his long period of study and practice! Who can wonder if he prefer becoming a consulting engineer, with less responsibility and more pay!—Five per cent. on the capital expenditure incurred in constructing works, the success of which depends upon his constant care and skill, for which he is to receive 8s. 6½d. per day.

But he is to be allowed to take one pupil, who, in exchange for being trained for obtaining a similar prize in the distant future, will be expected to pay in premium some little addition to his mentor's income.

If Lieut.-Colonel Crompton be right in his belief that a very large number of junior and ill-educated men blossom into consulting engineers, and "do" a large number of towns, from what class are the skilled men to be drawn who will accept such remuneration for undertaking the supremely important duties of electrical engineer in charge of municipal supply works, with the exceptional difficulties attaching to the direction of their work by a Committee ignorant of the business?

The action of the Tonbridge local authority is eminently calculated to secure the *unfit*, with the result that the young borough electrical engineer, even if successful in supplying electricity without any serious mishap, will soon yearn for

the better paid position of a consulting engineer, whose first job will realise for him in his 5 per cent. commission as much as he would earn in working a station for many years. Thus he has no permanent attachment to his position, and must always be ready to give it up for any addition to his "screw."

The survival of the unfit and the creation of an inferior class of consulting electrical engineers is a phase of municipal trading, the ignorant employers being unable to discriminate in the selection of the men upon whose successful working everything depends. In selecting their engineers upon economical principles, their ideas are limited to the rate of wages. It will, no doubt, be very difficult to make the municipal undertaking at Tonbridge pay its way, but no worse economy could be practised than under-paying the man responsible for making it a financial success, or, in any case, for reducing the loss as much as possible.

Lieut.-Col. Crompton has displeased some people by his fearless statements, but his frankness and honesty of purpose really entitle him to the gratitude of all who wish well to the industry.

There is another chance for the class of consulting engineers indicated by the gallant Colonel, in a paragraph in the *Edmonton Guardian* of last week. A correspondent gives a copy of a recommendation by a Committee of the Urban District Council, that *three* electrical engineers shall be consulted when the electric lighting order obtained in the present session is being dealt with.

When the combined scheme of the five local authorities, of which Edmonton was one, was being promoted in 1901, Mr. Robert Hammond was called in to check the recommendations of Mr. Hawtayne, and they became the joint consulting engineers; but the Edmonton Councillors appear to have determined upon going one better, and, to make assurance trebly sure, would appoint *three*—to whom, we suggest, might be added an umpire, to decide in case they should each advise a different system.

Meanwhile, surely the truth must be dawning upon these representatives of the ratepayers, that they are groping in the dark in undertaking a speculative business for which there is absolutely no sound reason, and which experience has amply proved will, in all probability, result in heavy demands upon the rates.

According to the report referred to, the committee advise an alternative course, by applying to a company able to supply all that the district requires, without risk to the ratepayers, and upon better terms than it is possible for an isolated municipal undertaking to accomplish; in this recommendation there is the dawn of reason and sound sense, which it is to be hoped will ultimately prevail.

South Africa.

We have read a good deal of late about the industrial boom that we are to expect in South Africa, and cannot help feeling that in this connection there are some at work who design to trumpet forth the alleged backwardness of this country until their blastings produce something approaching a scare. Fancy figures are published about enormous contracts which have been placed in America for electrical machinery for use in South Africa. How often are these figures set a-winging by Americans with whom the wish is father to the thought? Have they any foundation in fact? German manufacturers are also said to be ready to pounce—indeed, have already pounced—but while we admit the fact, we give a knowing look over our glasses and sympathise with those who have had perforce to live so long upon their losses, and have been dumping their products anywhere and everywhere at any price they can get, just to keep the works a-going. Contracts will go to Germany, and contracts will go to America, for electrical and general engineering development in South Africa, for there are American and German engineers in positions of authority; but contracts for millions and millions of pounds' worth of stuff will come to this country, and yet millions more will come here instead of to others if we are able to take the orders. But on what terms shall we take the business that is going? In exceptional cases it may pay in the long run for our firms to incur a loss at first in order that they may become known—pay their footing, so to speak; but heaven forbid that when there is so much to do, and so much more coming—we refer to electric power and traction progress even within our own tight little islands—we should be guilty of trading recklessly, and repeat the blunders that have been made by German manufacturers. We are advocates of the go-ahead spirit and of up-to-date enterprise; but we are also advocates of the exercise of just a little of that caution which has become one of our national characteristics, and seems to be so sadly lacking on the part of some of our foreign rivals. May we be pardoned for suggesting that at the present moment there is a too evident disposition to regard South Africa as a dumping ground for ne'er-do-wells, a sort of labour rubbish heap; it should be nothing of the sort. We are not going to "develop" a Madagascar, but a British territory. The British electrical engineering industry must be ably represented by men who know their business. Mr. Chamberlain's view on the question of trade rivalry is that the British manufacturer will win if he will only make adequate effort and throw himself into the battle in an enterprising way. The Secretary for the Colonies seems to favour this view at the expense of preferential treatment, and our past commercial history might be cited in justification. Our own belief is that the British electrical manufacturer is pretty well alive to the necessities of the situation.

Education, Legislation, and Commerce.

Mr. Ivan Levinstein's presidential address to the annual meeting of the Society of Chemical Industry in Liverpool took for its subject "Education and Legislation—their Influence on Trade and Industry. Mr. Levinstein began by regretting that we had already lost our premier position as the manufacturing country of the world to the United States, and by stating that we must now fight Germany for the second place. But if Germany is a larger country than the United Kingdom and contains a larger industrial population, and if the same remarks apply with far greater force to the States, if, too, we have worked our deposits of coal, iron, &c., for so many years that they are becoming more expensive than of yore, whereas the similar raw materials in Germany and North America are comparatively untouched, surely it is patriotism run mad to expect us to retain our superiority over the younger nations. Mr. Levinstein assigns eight reasons for Germany's advance in industry and commerce:—(1) Superior economy and attention to detail; (2) possession of more skilled brains; (3) a close alliance between legislation and science on the one hand and trade on the other; (4) a national system of railways and canals, with far cheaper freight charges; (5) cheaper skilled labour working for longer hours; (6) a large supply of unskilled labourers trained to habits of punctuality and discipline by military service; (7) protective tariffs; (8) better patent laws. Of these perhaps (1) cuts both ways: German goods are sometimes made too cheaply to be economical; (2) should read "employment"—we have the brains, if our manufacturers would only utilise them; (3), (4) and (5) are absolutely true, especially the two last; (6) is equally true, and undoubtedly serves to make many employers believe in conscription, and exalt the methods of the sergeant over those of the board school teacher; (7) and (8) are perhaps more polemical; but the first is matter for the statesman to consider, while the second is obscure, for, if it is certain that our patent system has manifold defects, it is no less certain that the German method is far from perfect.

SOME SUGGESTIONS WITH REGARD TO ELECTRIC MOTOR INSTALLATIONS.

By ALFRED H. MAYES.

It is much to be regretted that, in so many instances, want of method and attention to detail on the part of those responsible for the design and erection of electric motor installations, should—as is so frequently the case—ultimately prove the cause of trouble and dissatisfaction to the user.

The principal causes of stoppage and annoyance could generally be avoided by the exercise of a little forethought, and the writer proposes, as far as the limit of a short article will permit, to point out some of the most prolific sources of difficulty, and to make a few suggestions, the value of which he has proved from practical experience under varying conditions.

Selection of the Motor.

Direct current motors, carefully and thoroughly well constructed, are now obtainable from our leading makers, and, with reasonable care during use, and when selected with due regard to the circumstances of the case and the nature of the work to be performed, are seldom the cause of trouble—in fact, they may fairly be classed as the most simple and satisfactory of machines.

In many cases the partially protected or ventilated type of motor could have been safely and successfully employed in place of the totally enclosed motor used, and with an increase in efficiency of something like 20 per cent. on account of the lower running temperature ensured by the ventilated shell.

The writer has seen many excellently designed motors of this class, the ventilating ducts being so placed that it would be practically impossible for any rubbish or other detrimental matter to find its way into the interior and so cause injury. Excellent results are obtained by the use of liberally designed ventilating spaces, covered with wire gauze, such an arrangement keeping out all but the finest particles of matter, whilst efficiently ventilating the armature and field coils.

A point of the greatest importance in every type of motor is that the commutator and brushes shall be readily accessible, and the commutator box should therefore be provided with large doors fitted with clear mica windows, in order that sparking under the brushes may be detected immediately it occurs. Mica will be found altogether superior to glass for this purpose, on account of the great chance of breakage when the latter is used.

There is, of course, always a possibility of the brushes working loose and becoming displaced in even the best of motors, such a mishap setting up destructive sparking; this may continue for a considerable period without detection in cases where no view is obtainable of the commutator, and much damage may have ensued before the trouble is remedied.

There are frequently cases in which it is essential that the shell of the motor shall be both dust and air-tight, and first-class motors of this type are readily obtainable when necessary.

Motors of the completely open type, so often left unprotected, should be provided with strong sheet-iron covers, lined with asbestos millboard and suitably ventilated, care being taken that the ventilating holes are pierced high up in the sides of the box or cover, and never at the top, as otherwise undesirable articles, such as screws, nails, &c., will certainly find their way into the interior, and may easily be the cause of serious injury and breakdown to the motor. It is an excellent plan to make the top of the iron cover in the form of a lid, completely removable, in order that the motor may be inspected with facility at any time.

When the machinery is belt-driven, it is of the highest importance that the motor should be provided with slide rails, the small extra cost of which will be amply repaid by the ease with which the tension of the driving belt can be adjusted at all times.

Selection of the Accessories.

It is, however, the accessories, such as the starting switch, main switch and fuses required by every motor, that are most frequently the cause of trouble and breakdown, and it is in the selection and arrangement of these that care and forethought are so frequently wanting.

By many contractors, that all-important item, the starting switch, is selected without the slightest regard to the nature of the work to be performed by the motor, price being, in all probability, the chief factor governing the choice.

In large printing works the writer has seen starting switches in operation, the design and capacity of which were only suitable for the lightest and most intermittent duty, whereas they were called upon to perform heavy and continuous work for which an apparatus capable of controlling the speed of the motor was really required. The result, as may be imagined, was a continual series of breakdowns and stoppages, with the usual accompaniment of loss and annoyance.

It is a matter for regret that starting switches of the cheapest and most flimsy construction should be so largely employed in conjunction with carefully constructed and high class motors, such as are now being produced by our well-known manufacturers. Bearing in mind the important nature of the work this accessory has to perform, it is indeed ill-advised economy to purchase the cheapest article obtainable, as the use of such frequently leads to serious damage to the motor it is supposed to protect, and results in a bill for repairs, the amount of which would have purchased half a dozen reliable starting switches.

In selecting a starting rheostat for a motor of any given H.P. and voltage, the contractor should specify that the current passing with the switch arm on the first contact shall not exceed the full load current required by the motor, there being many cheap rheostats in the market, the total resistance of which is so low, that a current considerably in excess of full load passes on first closing the circuit, the result being that the motor and machinery driven are subjected to a severe and sudden strain, due to the too rapid acceleration of the motor armature.

In the case of motors taking a current of over 50 amperes, the resistance should be so designed, that a current not exceeding that value shall pass with the arm on the first contact, and also that the rise of current between succeeding contacts shall not exceed that figure.

It may be urged that in some cases the nature of the starting load is such that the motor requires a current in excess of full load in order to start, but this does not place any difficulty in the way of adhering to the above figures, inasmuch as a properly designed resistance will permit of the current reaching the required value by degrees.

That the evil arising from heavy rushes of current when closing the motor circuit is a serious one in several respects, is shown by the fact that many supply companies are paying close attention to the matter, and are limiting the rise of current allowed with the arm on the first contact of the switch and also the rise between succeeding contacts. The principal reason for this limitation, from the supply company's point of view, is the fact that complaints have constantly been made by consumers of fluctuation in their lights, and investigation has generally proved this trouble to be caused by the defective starting resistances used in connection with motors supplied with current from the lighting mains.

It is also of the highest importance that the carrying capacity of the resistance should be ample; otherwise the result will be that the rheostat will over-heat and soon be destroyed, causing an often costly stoppage of the machinery whilst repairs are being effected.

Under no circumstances should a starting switch be used unless provided with automatic release for no voltage; that is to say, the construction must be such that the contact arm automatically returns to the off contact immediately the main switch is opened, or in case of the current failing from any other cause.

If not so constructed, there is, of course, a serious danger of the contact arm being left in such a position that all resistance is cut out of the armature circuit, and the next time the main switch is closed a terrific rush of current will

take place, causing heavy sparking under the brushes, and in all probability damaging the commutator.

In the case of large motors, it is very desirable to provide some form of slow starting gear, several types of which are obtainable, it being difficult to impress the average user with the absolute necessity of moving the contact arm slowly from one point to another, in order that the increase in speed of the armature, and consequent rise in back E.M.F., may compensate for the various sections of resistance cut out, and thus keep the starting current normal.

Switches constructed to deal with considerable currents should always be provided with contacts which can be readily renewed when damaged by burning, and this should always be possible without difficulty or interference with the switch itself.

One of the mistakes most frequently met with, is that of placing the fuse in juxtaposition to the starting switch, and consequently, if it is of the open type so commonly employed, entirely at the mercy of the operator, however inexperienced.

The fuse may, in the first instance, have been carefully selected, and its carrying capacity be such that it would not allow a current capable of injuring the armature of the motor to be maintained, but should it melt, from an overload or from any other cause, it will almost invariably be replaced by a larger gauge, or frequently two strands are put in by the operator, who probably objects to having his machine brought to a standstill. The writer has seen a 30-ampere fuse replaced in this way by a piece of metal which would have carried some hundreds of amperes.

For the foregoing reasons, all fuses should be grouped together under lock and key, and in the charge of a responsible person, each fuse being distinctly numbered, and also the motor corresponding with it.

A supply of standard and tested fuses should always be kept on hand, as otherwise makeshift devices of unknown and, probably, unlimited capacity are sure to be found between the fuse terminals.

There is a tendency amongst some engineers to avoid the use of fuses in motor circuits, and to use instead circuit breakers, but can it be said, even by the strongest advocate for their use, that the circuit breaker is an absolutely reliable safeguard?

As in the case of most mechanical contrivances, there is always a chance of failure to act, which may arise from numerous causes, and such a failure may mean the partial destruction of a costly armature. Where circuit breakers are employed the writer strongly advocates the use of a fuse in addition, the capacity of the fuse being about 20 per cent. in excess of the current at which the breaker is expected to act. A properly selected fuse is an absolute safeguard against damage to the motor armature, and bearing in mind its cheapness and the small space required, it is difficult to justify its omission.

That some prejudice against the use of fuses should exist is perhaps not at all remarkable, when one remembers the extremely crude and unscientific devices which were, and are to some extent, still honoured with the name. These usually consist of a porcelain base provided with two terminals, around which the ends of the fuse wire are looped.

The result of using such an arrangement is that every time the fuse does the work for which it is intended, that is to say, melts and breaks the circuit, the momentary flash does a certain amount of damage by partially fusing the terminals and gradually chipping and cracking the porcelain base, and finally the whole affair falls to pieces.

Needless to say, such crude devices should never be used, and there is no excuse for doing so, as scientifically constructed fuses are now readily obtainable at an extremely moderate cost, which may be fused on a dead short circuit without injury to the terminals or other parts.

Each motor circuit should be provided with a main switch so placed that the current can be entirely cut off from the motor when not running. The switch should be of the double-pole type, of strong and sound construction, and enclosed in an iron case with only the handle projecting.

The writer wishes here to enter a protest against the flimsy toys which are so much in evidence, and designated "main switches."

As far as can be seen, there is no justification for the desperate efforts which some makers exert to restrict the size and general proportions of the parts required. Both brass and copper are, of course, expensive materials, both in the raw state and to shape and finish for use, but there are undoubtedly many parts of a main switch for which cast-iron, preferably enamelled, could be used, copper being used for the current-carrying parts and rubbing contacts only.

This would allow of the whole switch being designed upon a more liberal scale, and made capable of carrying a handle which a man could get hold of.

In conclusion, the writer ventures to urge that careful attention to the few suggestions given above will frequently save much annoyance and considerable expense.

PROCEDURE ON APPLICATION FOR LICENSE OR PROVISIONAL ORDER.

[BY A LEGAL CORRESPONDENT.]

(Concluded from page 167.)

The Effect of a License or Provisional Order.—Undertakers who are duly armed with a license or provisional order may, subject to the provisions of the Electric Lighting Acts and of the Board of Trade Rules, and the terms of the license or provisional order, for the purpose of supplying electricity, do all or any of the following things:—Acquire such land by agreement, construct such works, acquire such licenses for the use of any patented or protected process, inventions, machinery, apparatus, methods, materials, or other things, enter into such contracts, and generally do all such Acts or things as may be necessary or incidental to the supply [45 and 46 V., c. 56, S. 10].

The powers specified in this section are amplified and set out in greater detail in the Electric Lighting (Clauses) Act, 1899, SS. 7—20, to which reference should be made.

It remains to consider what rights are conferred upon undertakers by this section. In the first place, it seems that the *amount* of land which they may obtain by agreement is quite unsettled; thus it might be convenient for them to obtain more land than absolutely necessary in order to prevent the close proximity of their generating station being a nuisance.

In entering into contracts with the local authority, the undertakers must bear in mind the provisions of the Public Health Act, 1875, where it is provided that every contract made by an urban authority whereof the value or amount exceeds £50, "shall specify some pecuniary penalty to be fixed in case the terms of the contract are not duly performed." It has been decided that this enactment is obligatory and not merely directory; and that, if the penalty is not specified, an action on the contract against an urban authority cannot be maintained [British Insulated Wire Company *v.* Prescot Urban District Council [1895], 2 Q.B., 463, 538]. On the general question of liability under such contracts, see also:—Hunt *v.* Wimbledon Local Board, 4 C.P.D., 48; Young *v.* Leamington Corporation, 8 App. Cas. 517; Bournemouth Commissioners *v.* Watts, 14 Q.B.D., 87; Melliss *v.* Shirley Local Board, 16 Q.B.D., 446].

Special Provisions when Local Authorities are Themselves Undertakers.—Where the local authority are undertakers, a clause is usually inserted limiting the amount to be purchased under the above section to 5 acres [62 and 63 V., c. 19, Sec. 8, ss. (1)], and this rule applies where the undertaking of a private company or person is transferred to the local authority. The "*works*" which the undertakers may effect include electric lines and any buildings, machinery, engines, works, matters, or things, of whatever description, required to supply electricity and to carry into effect the object of the undertakers.

Seeing that enabling powers of very wide extent are conferred by this section, it might be thought that undertakers, in carrying out their works, are entitled to interfere with the public by committing nuisances, &c. The form of provisional order, however, always provides that "nothing in this order shall exonerate the undertakers from any indictment, action,

or other proceedings for nuisance in the event of any nuisance being caused by them" [62 and 63 V., c. 19, Sched. S. 81].

Area of Supply.—As has been already pointed out, the Board of Trade may grant a license or a provisional order to any local authority, company, or person to supply electricity within *any area*. In the case of a local authority, a license may be granted authorising them to supply electricity within any area, although the same or some part thereof may not be included within their own district [45 and 46 V., c. 56, S. 3, ss. (7)]. Further, in cases where undertakers (not being themselves the local authority) seek a provisional order enabling them to supply electricity within the district of any local authority, they must, in the first instance, give notice on or before July 1st in the year of the application to that local authority that such provisional order has been, or is intended to be, applied for [45 and 46 V., c. 56, S. 4, ss. (1)], and they must not only give notice, but must obtain the consent of the local authority in writing [B.T.R., Rr. ii., iii.], unless for some reason the Board of Trade see fit to dispense with such consent [51 and 52 V., c. 12, S. 1]. Where the undertakers have been unable to obtain the consent of the local authority, a request from them asking the Board of Trade to dispense with the consent must accompany their application. Reasons for the request must also be given [B.T.R., R. ii.].

It is to be observed that the grant of a license or a provisional order does not confer any monopoly upon the undertakers. Thus it is provided by Sec. 1 of the Electric Lighting Act, 1888, that the grant of authority to any undertaker to supply any electricity within any area, whether granted by license or by means of a provisional order, shall not in any way hinder or restrict the granting of a license or provisional order to the local authority, or to any other company or person within the same area [51 and 52 V., c. 12, Sec. 1].

Competing Applications.—The Electric Lighting Acts are silent as to any question of priority in the grant of applications made by more than one body for provisional orders. The Board of Trade, however, acting under their statutory power [45 and 46 V., c. 56, Sec. 5] have made a rule that when applications for provisional orders authorising the supply of electricity within the district of any local authority are received by the Board of Trade from such local authority, and also from any other authority, company or person, the Board of Trade will give a preference to the application of the local authority of the district in every case where, in the opinion of the Board, no special circumstances exist which render such a preference inexpedient [B.T.R. (1890)].

THE CYCLONE THEORY OF MAGNETISM.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Concluded from page* 136.)

As the motion of the fan continues, the region of peripheral compression progressively recedes before the advancing centrifugal waves towards the extreme limit of their outward course, to which the stratum of maximum pressure is thus relegated throughout the period during which the motion continues, while the region of axial rarefaction progressively advances along the surface of the vanes from the extremities till the stratum of minimum pressure coincides with their advancing edges in the equatorial section of the fan. The vortical veins, being differentiated from the medium in which they are set up and from each other solely by the circumstance of their spiral vortical motion, necessarily participate in the general conditions set up by the stratification of that medium into spaces of varying pressure. The volume of medium involved in each spiral vortex remaining constant, the diameter and velocity of motion of the vortex necessarily alter with the varying conditions of pressure (*i.e.*, condensation and rarefaction) in the medium through which they are propagated. Thus, the proper motion of the centrifugal veins is an ever retarding motion, being a maximum when leaving the rarefied stratum adjacent to the periphery of the fan, where the diameter of the vortices and the velocity of each particle of the medium involved are also a maximum, and a minimum when attaining the region of greatest pressure at the portion of their course remotest from the generator.

The proper motion of the centripetal veins is conversely an ever-accelerating motion; the diameter of the vortices and the velocity of each particle of the medium involved being ever-increasing quantities, as the vortical veins pass from the strata of greatest condensation to those of greatest rarefaction, or from the portion of the space most remote from the generator to that nearest thereto. The action of the accelerating veins upon an extraneous particle (such as a bit of gold leaf, described in the first experiment) which should happen to come within the limits of the space thus vortically agitated will necessarily be greater than that of the retarding veins. This explains the fact tha the observed motion of the pieces of gold leaf as described in the first experiment is *ab initio* invariably towards the face. Mr. Weyher, applying this reasoning to the motion of celestial bodies in space, suggested that it might very well explain the phenomena of universal attraction or gravitation. Space in the neighbourhood of the revolving globes would be filled by vortical veins in the ether originating therefrom, acting upon obstacles in their path probably as the square of their velocity—the excess of the action of the centripetal or accelerating veins over the centrifugal or retarding veins being probably equivalent to a push towards the centre of motion, varying as the square of the distance therefrom.

It should be observed that in a vortically agitated space where the streams of motion at every point are crossing each other from opposite directions, any extraneous body which should happen to be introduced therein would forthwith be caused to revolve around an axis of its own, and thereupon would become the origin or generating centre of vortex motion localised around itself. If this extraneous body were either plastic or liquid it would also necessarily tend to assume a spherical shape as it revolved through space, just as a drop of water assumes this shape rolling through the atmosphere. If this extraneous body should be already endowed with a motion of rotation of its own, the establishment of a localised centre of vortical motion would be facilitated, as this proper motion would be intensified by repeated contacts with the never-ending series of fresh vortical streams, each of which would impart thereto some portion of the energy it received from the generator which set it going.

It would by no means be too far-fetched to suggest that the invasion of the vast eddies, or backwaters, of space, where Dr. See's cold primordial nebulæ collect, like fogs in the calm spaces of the atmosphere, by etheric cyclones originating in some existing solar system, might furnish the starting point of a new solar system. These etheric cyclones would differentiate a varying volume of the invaded nebula by communicating vortical motion thereto, which would eventuate in its permanent detachment from the inert remainder, and in sending it spinning across space on its appointed revolutionary journey through countless æons of time. Returning, however, to our hypothetical enclosed space, it is evident that the boundaries by which, for the sake of clearness, we have supposed it to be limited, are wholly unnecessary for the argument, since they were supposed to be situated just at the outermost limit of the vortical motion set up by a given generator in the surrounding space and without any influence thereon. The fact is that each centre of vortical motion is surrounded by a space completely filled with the vortical veins originated therefrom, and differentiated thereby as completely from all other space as if it were in very deed limited by definite bounds similar to those we predicated in our hypothetical case. If it be right to regard each atom as a centre of vortical motion and the environing ether space as divided into distinct volumes by the vortical waves belonging to each atom and originating therefrom, then it is easy to understand how the distance between the atoms or centres of motion is maintained constant, and how electrical and other undulations in the ether are able to produce distinct effects upon

matter built up of such atoms, altering its dimensions, its physical condition and its properties by direct action on the localised motion in the ether surrounding them, and thereby on the proper motion of the atoms themselves. The transition from the idea of these centres of vortical motion to the ideas embodied in Lord Kelvin's atomic theory, by which atoms themselves consist solely of vortex rings with more or less complex convolutions or knots, is sufficiently obvious. It would be indeed strange if it turned out that this, the only atomic theory which we have not derived from the ancients, should turn out to be the key to the interpretation of the phenomena both of the immeasurably vast regions of space outside our globe and of the immeasurably small particles of which that globe itself is composed.

We will close our review of Mr. Weyher's experiments by quoting two more, in which he successfully reproduced the characteristics of cometic motion. While revolving a spherical fan, which produced vortical waves in the atmosphere similar to those in fig. 1, he liberated a small balloon filled with gas and ballasted so as to float at the height of the revolving fan in its immediate neighbourhood. This was at once caught in the vortical whirl and carried past the revolving sphere, following exactly the hyperbolic path of a comet. Similarly several balloons of different sizes when liberated all followed the same path, sorting themselves out in an elongated stream like a comet's tail, the largest being the nucleus, and all being individually subjected to the attraction of the revolving sphere in proportion to their size. The second experiment was made with a bag forming the bottom of a box, similar to that described in reproducing the magnetic spectrum. In the bottom of this fine sawdust, or, better still, bolted bran of various grades, is placed, the fan is set revolving, and vortex streams are produced. Thereupon the grains of bran begin to circulate, forming one or more groups separated from each other, each of them moving with the grosser particles at its head, each of them reproducing the image of a comet. The grosser grains are followed by an attenuating tail composed of the smaller particles sorted according to size. Are not these experiments an additional proof that the same laws run through the universe from A to Z, and that it is more than improbable that the various phenomena we have considered spring from any other source than vortical motion, for which the all-pervading ether furnishes the appropriate vehicle?

REFUSE DESTRUCTION: ITS SANITARY AND STEAM-RAISING ASPECTS.

By FRANK BROADBENT, M.I.E.E.

(*Continued from Vol. L., page* 1001.)

III.

Records of the relationship between the variations of temperature in the combustion chamber or flues, and the steam pressure in the boiler, have from time to time been made. Data relating to some very thorough tests carried out by Mr. Priestley, on the Nelson destructor, and published in a paper read by him before the Public Health Congress, 1901, contain some interesting figures and curves bearing on this point. The two curves given in fig. 1 are based on the figures obtained during a maximum consumption test of eight hours' duration, with, what might be called, a "flying start." The combustion chamber temperature was obtained by means of a Callender recording pyrometer, and as is seen

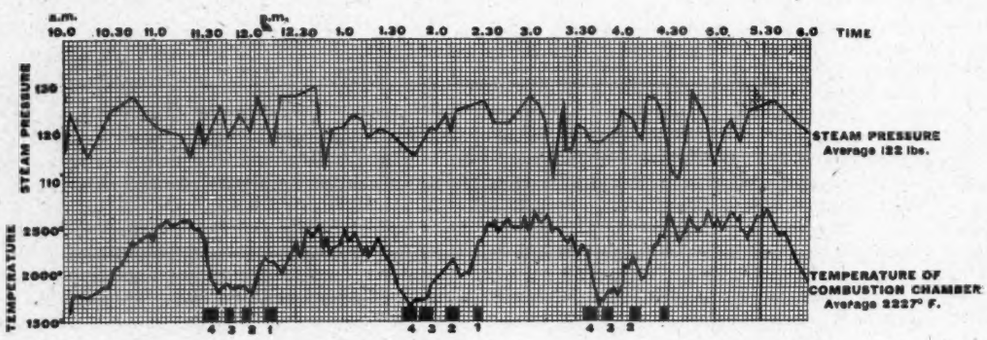


Fig. 1.

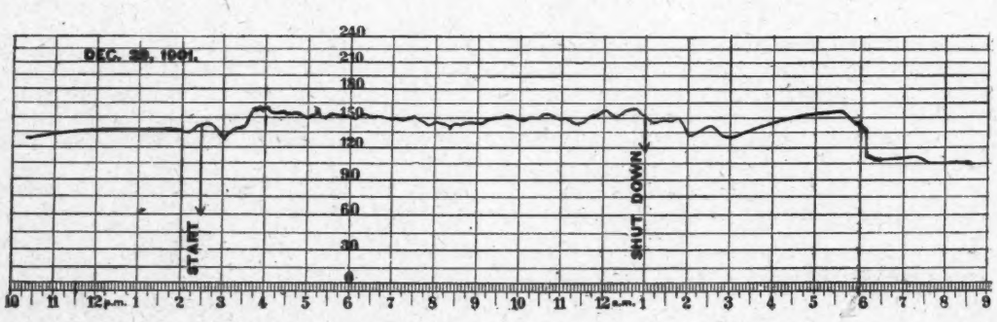


Fig. 2.

from the curve, this varied from 2,693° F. to 1,666° F., averaging 2,227° F.

This variation is approximately equal to 20 per cent. up, and 25 per cent. down, from the average value.

The steam pressure in the boiler, which is of the Lancashire type, averaged 122 lbs., the highest and lowest readings being respectively 130 and 100 lbs., representing approximately 6·5 per cent. rise and 18 per cent. fall, or about half the percentage of temperature variation. Whilst the configuration of the two curves indicates that the variation in the steam pressure follows to some extent that of the combustion chamber temperature, it is apparent that the variation is not due to temperatures only, as the four lowest points occur when the temperature is highest. Feed pumping probably accounts for this, as the feed temperature was only 85° F., there being no economiser.

Eliminating these four points, the lowest steam pressure is 115 lbs., a fall of less than 6 per cent., making a total variation of about 12·5 per cent., with a variation of 45 per cent. in the temperature of the combustion chamber.

The numbers and reference marks at the foot of the

diagram gives the times of clinkering the four furnaces. No. 4 furnace, being next to the combustion chamber, produces the greatest temperature variation.

Fig. 2 is a reproduction of a typical steam-pressure chart from the electricity works at Wrexham. This shows the variation during a period of 24 hours. The boiler is of the Lancashire type, working in conjunction with a Meldrum "Simplex" destructor.

From the chart it is seen that on commencing the day's run at 2.30 p.m. the steam pressure stands at over 140 lbs., although the fires have been banked for about 14 hours. After settling down, the variation from 3.30 p.m. till 1 a.m., when the station is again shut down, does not rise above 160 lbs. nor fall below 140 lbs., a variation of about 6·5 per cent. up and down from 150 lbs. This agrees very closely with the Nelson figures. The combustion chamber temperatures in the two cases would no doubt be very similar, as the make and size of the destructors are the same. No record of this is yet kept at Wrexham.

It will be seen from the chart that the steam pressure commences to fall about half an hour before shutting down; this is due to clinkering. The fires are then banked up for the night and not touched till 2 or 3 p.m. The variations occurring whilst the station is shut down are due to the pumping of water from the deep well and also to boiler feeding. This is done by a watchman, who controls the steam pressure by means of the dampers.

So much for constancy of steam pressure. Although some of the best published results in steam raising from refuse destructors are those in connection with electric lighting stations, it is obvious that this is not the class of work best suited to the conditions of destructor working, either from the economical steam raising, or cremation points of view.

The chief condition necessary to efficiency in either of these departments, is that the furnaces should be kept at a high temperature night and day. Summer and winter alike, the amount of refuse to be destroyed does not, except under special circumstances, vary considerably; in holiday resorts there may be more in summer than in winter, and in a purely residential quarter, the reverse may be the case.

These conditions are quite different to those obtaining in electric lighting work, where the load occurs during a small portion of the day only, and where the winter load is almost invariably greater than that of summer. Apart from any question of thermal or of destructive efficiency, by designing a destructor plant for continuous working, the initial cost is reduced to a minimum, as the refuse is burnt at its lowest possible rate, and, therefore, the size of destructor necessary, is kept down to its smallest dimensions.

In the early stages of an electric lighting undertaking, the load is, of course, small, and occurs during only a small portion of the day; if, therefore, a refuse destructor is run in combination with the generating plant, it means that only a small portion of the daily refuse can be burnt during lighting hours, if the destructor is designed on lines of reasonable economy.

During the hours of light load, very little use can be made of any heat from the refuse, unless some form of storage be adopted.

In some generating stations, combined with refuse destructors, it is the custom to blow off steam, to run steam plants idle, to shut off the forced draught, or to divert a portion of the hot gases direct to the chimney without passing them through the boiler, in order to get rid of the heat. The first two methods are unquestionably most inefficient, even assuming the water to cost nothing; it is bad enough to have to throw the heat away; it is worse to throw water, oil, &c., away in addition.

The stopping of the forced draught in order to reduce the temperature of the furnace, tends to defeat the primary object of the destructor, and it were better that no attempt be made to utilise the heat than that this should be done.

When the hot gases are passed direct to the chimney, it is important to provide cold air inlets to reduce the temperature, in order to prevent damage to the brickwork.

Everything which tends to smooth out the peaks of the load curve makes for economy and efficiency in any electric generating station, and in a station which includes a refuse destructor as part of the steam raising plant, this is even more important.

A street lighting load, and an accumulator load, are, therefore, most desirable factors in early stages of the running of a small combined destructor and lighting station.

The weight of refuse for disposal per 1,000 of population varies, somewhat, with the locality; but, speaking generally, the average may be taken at about 1 ton per 1,000 people per day of 24 hours.

From the published analyses, we can form some idea of the calorific value of the refuse in different parts of the country. It will then be interesting to compare actual results obtained with these theoretical values.

It was shown in Table III., assuming the analyses of Codrington and Russell to hold good, that the calorific value of average London ash-bin refuse is 1,428 B.T.U.

Working on the same lines, that is, taking as a basis for calculation the published analyses of the refuse and the relative calorific values given in Table III., we obtain for Manchester refuse the value 3,100 B.T.U., and for Torquay winter refuse 1,480 B.T.U. per lb.

Manchester is taken as representative of towns in a coal-field district. Torquay is not quite typical of a seaside holiday resort, as, to a large extent, it is a wintering quarter, and the winter refuse is better from the calorific point of view than is that of summer.

In order to calculate from the above data the probable evaporative efficiency of the refuse, when burned in a high temperature destructor, it is necessary to have some standard for comparison. This, fortunately, is now available, as Mr. Brookman, the resident engineer at the Rochdale Sanitary Works, has recently carried out a test with the object of determining, approximately, the evaporative efficiency of slack coal burned on a "Simplex" destructor grate.

The coal used was boiler slack at 7s. a ton, and the evaporation was equal to 7·33 lbs. per lb., from and at 212° F. Mr. Brookman is of opinion that this figure could be exceeded, but as it stands, it is better than is generally obtained under ordinary conditions of internal firing, that is, hand firing, and natural draught.

Assuming for the coal a calorific value of 12,500—a figure confirmed by other tests—the following (Table IV.) are the results that might be expected, where the fuel is burned under equal conditions:—

Table IV.

Fuel.	Approximate calorific value.	Evaporative efficiency in lbs. from and at 212° F.
Coal	12,500	7·33 lbs.
London refuse	1,428	0·84 "
Manchester refuse	3,100	1·82 "
Torquay refuse	1,480	0·87 "

(To be continued.)

CORRESPONDENCE.

Fire Prevention.

On reading the article on fire prevention in your issue of 11th ult., I was much struck by the fact that, although yours is a purely electrical periodical, you, curiously enough, made not the least mention of automatic electrical appliances for preventing such outbreaks as the Queen Victoria Street fire. Since then I have noticed in your last issue a letter from "Fire Protection," in which the writer incidentally mentions such devices. Now, as an electrical engineer, I can scarcely permit the omission to go unnoticed, and trust you will allow me to make a few remarks.

No doubt, as you say, the sprinkler—by the way, the Grinnell is manufactured by a well-known firm of electrical engineers—is a "good thing," but, unlike the majority of good things, you can sometimes have too much of it. There are cases known to the writer where damage done by water has been very much more serious than that caused by fire, and the reason is this—that it is not only the valve

immediately above the outbreak, or the two or three valves nearest it, but a whole range of them sometimes, which give way and drown all the surrounding material and machinery, &c. Theoretically, of course, this should not happen, but stray currents of air have an unhappy knack of knocking theory into a cocked hat. One sample of sprinkler damage will suffice. A warehouse filled with valuable laces was protected by sprinklers, and a fire took place in a waste-paper box in the office situated at one end of the flat. The firemen carried out the box containing the fire (!) unextinguished in their hands, with not a drop of water near it; and the insurance company paid between £1,000 and £2,000 for water damage.

At the same time, I have no wish to be misunderstood. Sprinklers undoubtedly justify their existence; but I wish only to make clear that they are not the only device which does so.

The writer has fitted up a goodly number of automatic electric alarms of different kinds, which during several years' experience he has never found to fail in reporting a fire. In one factory alone, out of three consecutive outbreaks, two were extinguished by the company's staff—these having occurred during working hours—and no claim was made; the third one awakened the gatekeeper and the engineer out of their beds about one o'clock in the morning; they located the fire, called up the fire brigade, and the fire was extinguished with a fire damage of only £20. In this case, the insurance company admitted that several thousand pounds would not have covered the damage had there been no automatic alarm system, owing to the peculiar position in which the fire originated. Sprinklers could not by any possibility have quenched it, and the net result of a sprinkler would only have been to increase the damage by at least some hundreds.

Your reference to Sir E. M. Shaw reminds me that he is chairman of the May-Oatway Fire Appliances, Limited, of New Broad Street, who own the May-Oatway automatic fire detector. This invention, which is of British Colonial origin, has undoubtedly justified its existence, and I venture to think has a record at least as good, if not better, than any sprinkler. In every case I feel sure that an automatic alarm system, combined with a system of either chemical extinguishers, as "Fire Protection" suggests, or of ordinary hose reels and water connection, would minimise to a great extent the damage done by fire, and be the means of saving life and property, and are fully worth consideration by owners of warehouses and factories.

John D. Mackenzie.

Glasgow, *July 28th*, 1902.

[The value of electric *alarms* is unquestioned. The point which our correspondent overlooks is the fact that in the Queen Victoria Street fire, the subject of our article, electric appliances would have been useless; there were persons actually in the room where the fire broke out! Sprinklers would have extinguished the fire, while an electric alarm would have merely drawn attention to it.—Eds. Elec. Rev.]

Technical Education.

In view of the recent outcry for technical education, I should like to ask a few questions.

1. While building new technical colleges, would it not be advisable to render the present ones of more practical value?

The professors who guide the courses of study at the colleges do not seem to understand that a series of mental gymnastics in the "higher mathematics" do not constitute an engineer.

The system of education is wrong; what, for instance, is the good of giving a student elaborate formulæ for armature reaction, when turning to the next student he asks: "Which is the armature, the part that rotates?"

This is not a fancy case, and one may ask how such a student was admitted? The answer is—On the strength of his mathematics.

Again, professors take little interest in their students, save, perhaps, a few of those more than usually clever at mathematics; their duty ends at the lecture theatre's door.

If the professor but knew how many students there are whose interest is killed by the perpetual shower of incomprehensible mathematics, and his own chilling attitude to the asking of questions, he would be perhaps more than commonly surprised.

Many a student would like to have a "talk" with "The Pro," were he not made to feel that he was a nuisance, and taking up valuable time (not paid for by the college).

2. We read that "other countries have got hold of the systems of alternate and polyphase working," and that England "was *formerly* ahead in the working of continuous-current machinery."

True,—but till very recently indeed, England did not require polyphase working, her stations being all local and coal-driven, unlike the water-driven, long-power-transmission lines of the Continent and America.

Now that, however, polyphase machinery is required, British manufacturers will undoubtedly be able to design and build it, and I would point out that we first showed, and still show, the world how to build high-speed enclosed direct-coupled engines and dynamos for continuous-current working.

3. It is much easier to sit at home and criticise than to stretch out a helping hand to those who we think are in need of it, and many professors who think it their duty to pile obloquy on the work of the British engineer had better by far be employed in helping him.

If foreign goods are imported, it is owing in no small extent to the ill effects of their own words, which are readily absorbed by the non-technical and foreign-subsidised press.

Finally, may I plead that the student should be more practically educated, so that when leaving college he may not find himself a sort of white elephant, coming from colleges whose teachings are a bye-word amongst practical men, thus being ground between the stones of

Theory and Practice.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Paradox" writes:—"With reference to the question in the 'Legal Query' column of your current issue, I was under the impression that an invention worked out by an employé in Corporation time could not be patented, but became Corporation property. I shall be glad to know if this is correct, or if not, the actual law on the matter?"

*** With reference to the above query, we have but little to add to the answer which we gave to a somewhat similar question last week. Unless an employé is under agreement with a Corporation to surrender all inventions and all rights to take grants of letters-patent which he may work out or discover in Corporation time, or with Corporation materials, he can claim them for himself. Our correspondent (if he is employed by a Corporation) should look at the agreement into which he has entered.

"Alpha" writes:—"The Electricity Committee of a Borough Council have recommended that incandescent lamps should be renewed by the Council for their customers free of charge, the reason put forward being that customers used insufficient lamps, and complained to the Council of the bad lighting. They also propose to do small repairs to the fittings, and charge the cost. Is this legal as it leaves no chance for local firms to do this work for consumers.?"

*** With reference to the first part of the above query, namely, whether the Borough Council can renew incandescent lamps free of charge, it is presumed that the Corporation are working under the terms of some provisional order which gives them the right to supply electricity and to enter into agreements with consumers. If this be the case, and the Corporation are entitled to give supply at a certain price, they are entitled, in our view, to make what concessions they choose in the proper conduct of their business. As to the second half of the question, we should be glad to be able to answer this in the negative, but the privileges of municipal traders have often extended to the supply of electrical fittings, and we presume that in the case mentioned by our correspondent, the Council are within their statutory provisions.

PARLIAMENTARY.

Sir L. McIver's Tube Committee.

On Thursday last week a Select Committee of the House of Commons, consisting of Sir Lewis McIver (chairman), Mr. Whiteley, Mr. Emmott, and Mr. Montagu, commenced the consideration of a group of Bills comprising Brompton and Piccadilly Circus Railway (new lines), the London United Electric Railways, and the Piccadilly, City, and North-East London Railway.

Mr. Balfour Browne, K.C., said that before Sir Ralph Littler opened for the Brompton and Piccadilly Railway Bill, he might say something which would relieve him from going into unnecessary matters. He, with Mr. Moon, Mr. Coward, and others, represented the two other Bills in the group. One was the London United Bill, to make a railway from Hammersmith to Hyde Park Corner, and the other was to make a railway from Hyde Park Corner through Fleet Street for the City to the North-East London. They got a *locus standi* to oppose the Brompton and Piccadilly Railway, but he did not propose to oppose that Bill at all. He was merely there to watch the proceedings, and see that nothing was done incompatible with his railway. The only case where both railways would run under the same street was from Hyde Park Corner to Piccadilly Circus, and the Brompton and Piccadilly Railway were authorised there already, but were asking for an extension of time. The only case where the railway could affect him was at Piccadilly Circus and Leicester Square, where both railways ran under the same street. All he wished to see was that the Brompton and Piccadilly Company did not put their railway where it would block his.

Sir R. Littler, K.C., said the position was a peculiar one, for until a few moments ago he had had no notice. Before the Court of Referees Mr. Balfour Browne most strenuously insisted on having a general *locus*, and having got it, he said he meant to use it by laying low, and said he was not proposing to oppose the Bill.

Mr. Balfour Browne: You cannot compel me to oppose it, I suppose?

Sir R. Littler: I want you to say whether you are opposing or not.

Mr. Balfour Browne: I am not opposing.

Sir R. Littler: Then you withdraw your petition?

Mr. Balfour Browne: No.

Sir R. Littler said it was an ingenious device, and he was entitled to ask if Mr. Balfour Browne was opposing or not. If he was opposing on clauses, he would like to know what the clauses were.

Mr. Balfour Browne said they had not come to clauses, but he would promise to submit any clauses he proposed quite early to his learned friend.

The Chairman said Sir R. Littler had to open his case in any event. They would want to know about the financial proposals. Mr. Balfour Browne could adopt any course he pleased at his own risk.

Sir R. Littler said his clients had been put to enormous expense by the performance of their opponents, and he submitted that it was a case in which they should pay costs. Proceeding to open the case for the Brompton and Piccadilly Bill, Sir R. Littler traced the whole history of underground railway facilities in London. The Brompton and Piccadilly Circus Railway Bill was promoted in the year 1897. The great want of London at the time was a scheme which started from the South-West, and communicated with the North-East, and it was as a step towards that step—an instalment only—that powers were obtained for a railway from Brompton to Piccadilly Circus. In 1898 the promoters, in their confidence, did a rash thing. They issued a prospectus to the public without the assistance of any great financial house, and the result was it fell flat. In 1897 they had to meet opponents in Parliament, for the City and West-End Company promoted a line from Hammersmith Broadway to the City, along much the same route as his line. The Parliamentary Committee came to the conclusion that his scheme was the right one, and rejected the other Bill. In 1899 the Brompton Company got an extension of two years for the purchase of land and four years for the completion of works, and the first-named extension fell due on August 6th of that year. Well, they had to consider what to do, but two important factors came in, for the Metropolitan Railway and the Metropolitan District Railway had both come to the conclusion that electricity should be adopted as the means of transit. Then Mr. Yerkes came on the scene. In the meantime the District Railway had been authorised to construct a deep level line under their existing line from Earl's Court to the City, and the Baker Street and Waterloo Railway and the Great Northern and Strand Railways had been authorised. There was also the Charing Cross, Euston, and Hammersmith line in the air. Mr. Yerkes found all these schemes worthy of extension, and all that was wanted was a short line from Piccadilly Circus to Holborn, which would join up the Western system with the Great Northern and Strand. They were asking for power to construct that line.

In answer to Mr. Whiteley, Counsel said the whole of the District Railway lines would be converted to electrical lines. Some trains would run from Ealing and Hounslow, but they would all come to Earl's Court, and some would go as through trains to the North.

Proceeding, Counsel said that it was seen if the scheme was to succeed it must be done on some sound financial basis. Mr. Perks, M.P., and Mr. Yerkes formed a new company for the completion of the lines. That company was formed three months ago and consisted of strong American and English financiers. There was a capital subscribed of £5,000,000 by perfectly solvent people. £1,600,000 was absolutely subscribed, and £400,000 was due in a week or two, and the rest was at call. An arrangement had been made with the firm of Speyer & Co., who could supply capital as fast as it was required for any of those lines, and for this they were to receive 5 per cent. in shares of the company taken at par, and only 1 per cent. in cash, so that every ½d. of the capital was as secure as if it was in the Bank of England. The whole of the contracts for the Brompton and Piccadilly line had been let to responsible contractors, and the iron work was now being delivered. It was proposed to have a station for the generation of electricity at Lots Road, Chelsea; the site had been purchased, and the station was being built and was hoped to be completed in 18 months. For traction it would be the largest power station in the world, having a capacity of 50,000 kw. It would provide power for the District and allied lines. With regard to the proposed extension of time, it was probable that they would not require to use it, but they wanted the extension in case of accidents. As to the question of fares, they had the old-fashioned method of fares at so much per mile in the Bill, and also provision for three classes, the same as the Central London Railway Company. It was probable, however, that they would work on the same system as the Central London Railway.

The Chairman said the Committee would like to have a statement showing the capital and estimates of all these lines which it is proposed to work in unison. He understood that, although the other lines were not before the Committee, yet they treated the capital as that of a single company, and the Committee would like to know how they spread it over the different undertakings.

This Sir R. Littler promised to have prepared, and the Committee then adjourned.

At the resumed sitting on Friday last week, Sir James Szlumper, M.I.C.E., was examined by Mr. Monro on behalf the promoters. He said he was the engineer to the Brompton & Piccadilly Circus Railway. The only new work proposed was a line from Piccadilly Circus, and by this means they would be enabled to link up with the Great Northern & Strand Railway, and a through railway would be given right from Finsbury Park to Earl's Court. The cost of this new piece of line was £511,199, and there was also an item of £49,900 for subways. By joining the Metropolitan District Railway at Earl's Court, a connection would be formed with all the western suburbs of London, including Richmond, Fulham, Putney, Wimbledon, Hounslow, and other places. It was intended to have subways at Duke Street and Piccadilly Circus.

It has been suggested that this is only meant to be a "block" line, and that you do not intend to go on with it. What do you say to that?—My instructions are to go on with the work as fast as I can. I have commenced at Knightsbridge and have sunk two shafts to a depth of 65 ft. From the bottom of these shafts I am working along at the tunnel. I may say, too, that all the ironwork for the entire works has been already ordered.

Replying to further questions, Witness said he was now driving the tunnel along the road for the railway. He had to sink 12 more shafts for six stations for the sites of which all the notices to treat had been served.

In cross-examination by Mr. Lewis Coward, K.C., who appeared on behalf of the London County Council, Witness said he could not agree to the Council having control over the hoardings the company might erect in the course of the construction of their works, although he would not object to the control being given to the official municipalities in whose districts they might be erected. He was willing to give an undertaking not to interfere with or alter the existing levels of the London County Council's subway in Shaftesbury Avenue without the consent of that body.

Mr. Montagu (a member of the Committee) asked what was the nature of the soil the tube would run through.

Witness said it would be entirely in London clay. There was no gravel.

By the Chairman: His estimate of construction was £40 per yard forward for the railway and £150 per yard forward for the stations. Besides the sinking of the shafts, about 200 ft. of the tunnel had been excavated.

In reply to a request by the Chairman, Sir R. Littler promised to have the average cost per yard worked out, and a comparison of that cost made with the tube railways that had already been constructed.

Sir Hugh Owen, formerly permanent secretary of the Local Government Board, and at present chairman of the Commissioners under the Local Government Act, of 1899, said he travelled frequently between Crouch End and King's Cross. At King's Cross there was a great want of some means of communication with West London besides cabs and omnibuses. The connecting link proposed by the Bill would be greatly welcomed by residents in the North of London, who at present suffered great inconvenience.

Similar evidence was given by Mr. Geo. Spicer, of Enfield, and Mr. H. Jones, town clerk of Holborn.

Mr. Grinling, chief traffic manager of the Great Northern Railway, said that his directors were strongly in favour of the Bill. The proposed link would give the large suburban traffic of the Great Northern Railway an outlet to the western part of London, and would relieve the increasing congestion at Finsbury Park. The three lines, Brompton to Piccadilly, Piccadilly to Holborn, and Holborn to Finsbury Park, were to be worked together. It was desirable that there should be uniformity of working with regard to workmen's fares. He was not aware that as the Bills stood at present, the proposals in this respect were different in every case. He found from experience that all the benefit of cheap fares did not go to the workmen, for the cheaper the workmen's fares were, the more the landlords raised the rents.

Mr. Alex. Ross, chief engineer of the Great Northern Railway, and Mr. Allum, on behalf of the workpeople employed at Covent Garden, also gave evidence in support of the Bill.

Mr. Perks, M.P., chairman of the Metropolitan District Railway Company, said he was aware that statements had appeared in the Press, and had also been circulated in the House of Commons that he was supporting this scheme, simply as a block line so as to keep out other competitors, and that the scheme would be dropped as soon as it had served its obstructive purpose. He could only describe this as an absolute falsehood from beginning to end. He expected the railway would bring a very large business to the District Railway from the North and the West of London, and so long as his policy was followed, his company would support the undertaking in every way. The only difference between the present Bill and that which was considered by Lord Windsor's Committee was, that the proposed link between the Piccadilly Circus Railway and the District Railway at Charing Cross was struck out. The Committee presided over by Lord Windsor objected to the sharp curve in the connecting link as proposed. There were, however, much sharper curves on American railways. It was the intention of the Brompton and Piccadilly Circus Railway to submit to Parliament again next session this connecting link with modifications. The line would cost about £250,000, and if Parliament sanctioned it, it would give a through route from Earl's Court, *viâ* Piccadilly Circus to the City, and right away east. There was no pretence whatever for saying there was any disinclination to proceed with any part of their scheme. The causes for the delay in the construction of the Brompton and Piccadilly line were—first, the absence at the beginning of any physical connection with the Metropolitan District Railway, the fact that the District Railway Company had no money to spare, and also that people were waiting to see the results of the Central London Railway before investing money in other tube railways.

On Monday Mr. Perks, M.P., gave further evidence, and said that the companies promoting the Bills known as the Yerkes group had entered into a contract with Messrs. Speyer to provide the capital as it was wanted, for 5 per cent. paid in stock and 1 per cent. in cash. This financial firm was an English and American firm, but was controlled in England. There would be no controlling power over the lines by Mr. Yerkes, for the Underground Electric Traction Company, of which Mr. Yerkes was chairman, owned less than 10 per cent. of the District Railway Company's nominal capital. The capital of the District Railway was £9,000,000, and less than two-fifths of that was held in America.

The Chairman said the Committee did not care where the money came from, so long as it was good money.

Witness said the contracts for the proposed railway were already let, pending the passing of the Bill by the Committee. The £5,000,000 of capital of the new company was applicable to any of the undertakings of the company. Some of this was being spent on the generating station at Lots Road, Chelsea; £150,000 was being spent on the Great Northern & Strand Railway, and money was also being spent on the completion of the Waterloo & Baker Street Railway. Originally the power house at Chelsea was estimated to cost about £800,000, but, as a matter of fact, it could cost £1,250,000, the chief cause of the increase being due to the fact that the land, which was estimated to cost £80,000 actually cost £165,000. Another cause was that the works would be enlarged to provide power for the Metropolitan District Railway, the Brompton and Piccadilly Circus Railway, the Baker Street and Waterloo Railway, and the Great Northern & Strand Railway. The District Company were under an agreement to pay a rental of 5 per cent on half the total outlay and the other half of the capital would be provided by the other companies taking power. Witness proceeded to deal with all the capital powers of the various companies and the estimated expenditure on the undertakings. The total capital powers of the Brompton and Piccadilly Circus Railway, taking into account the powers sought in the Bill before the Committee, were £3,233,000. The estimates amounted to £3,056,234, and this, after deducting £70,000 which could not be issued owing to the payment of interest out of capital to the extent of £220,000, left a margin of £106,000 to cover claims for vibration and other contingencies. He thought that the vibration clause introduced into the Bills by Lord Windsor's Committee would lead to a good many fancy claims being made. The total authorised capital of the Baker Street and Waterloo Railway was £3,179,000 and the estimates for land and construction were £3,260,190, so that there was a deficiency of £81,190. The line had been completed from Charing Cross to Portland Road, or about two-thirds of the total line. The authorised capital of the Great Northern and Strand Railway was £3,200,000, and nothing had yet been done in the way of construction, although the contract had been made and everything was ready to commence. The estimated expenditure was £3,109,292, which left a balance of £90,708. The authorised capital of the Charing Cross, Euston and Hampstead Railway was £5,768,000 and the estimated expenditure £5,558,285, leaving £209,715 for contingencies. The total capital of the four undertakings was £15,000,000, and of this £5,000,000 had been obtained and the whole was obtainable.

Mr. Whiteley: The total capital of the undertakings, I understand, is £15,000,000. On how much of that can you lay hands?—We have £5,000,000 at call, and Mr. Yerkes will explain where the balance is if necessary.

Have you vibration clauses in all your Bills?—I am sorry to say we have. We have a margin of £106,000 for vibration claims, and I think that will be sufficient.

Mr. Montague: Why did you put the vibration clauses in the Bills?—We did not put them in. They were forced on us by the House of Lords, and we should be very glad if you struck them out.

The Chairman: Do you recollect any precedent for Parliament sanctioning 6 per cent. on the capital of a company for underwriting?—I am quite sure that Parliament has often sanctioned a good deal more. I do not know whether details have been given to the Committees, but we have often in promoting our Bills, put before a Committee financial charges of more than 6 per cent. Parliament sanctioned the whole of the 5 per cent. preference of the District Railway Company being issued to the contractors at 65.

Mr. C. T. Yerkes, chairman of the Underground Electric Traction Company, was called, and in answer to Sir R. Littler, said that he had been interested for the last 35 years in tramways and electric railways mainly in Chicago. He had become interested in the Metropolitan District Railway, and other railways in London, and thought it would be a good thing, and also profitable to electrify the Metropolitan District Company. He considered that the Brompton and Piccadilly Circus Railway would be a natural feeder to the District line. By the comparatively small expenditure of capital contemplated in the Bill, an enormous amount of capital already expended, or to be expended, would be utilised. It was necessary to put in the proposed link in order to make a perfect line from Finsbury Park to Earl's Court. No promotion money had been paid in the acquisition of these companies, and in one case they purchased the property at considerably less than one-half.

Sir R. Littler: Your fares will be as low as may be consistent with a paying concern?—I have no doubt that a 2d. fare will be the best fare that can be charged on the tube lines. That ought to be the universal fare on underground roads in London. One penny would not be enough. It costs the Central London Railway 1d. per mile to run their trains, and if they were to reduce their fares to 1d., I am very well satisfied that they would go into bankruptcy. It is an experiment which I don't think it is well to try; but still if other people who are running in opposition to us try it, we will try it, and then let the best man win. In America we carry passengers 12 miles for 2½d. By a low solid fare we build up the suburban districts.

Continuing, Witness said that in the tubes the trains would consist of two motor carriages and four trail cars, and on the District Railway three motor carriages and four trail cars. The stations would be entirely fireproof, and the signalling would be automatic. Signals would be placed at the stations and at every curve, so that it would be impossible for a driver to have a signal out of sight. The tunnels would be lighted throughout with an installation quite independent of that for the train, while in consequence of improvements they had made in the laying of the permanent way, and the character of the rails, he did not fear the vibration clause, if people were honest about it. The average speed would be from 15 to 16 miles an hour. The traction company would operate all the allied companies, and would guarantee the shareholders 4 per cent. on the capital. Over and above the 4 per cent. they would also give to the shareholders one half of whatever profit was made. He believed that in this way they would make it much easier for the bankers to finance the company. The agreement was a private one, and was not scheduled in the Bill.

Replying to Mr. Emmott, Witness said it was entirely a matter for Messrs. Speyer & Co., as to whether the public were asked to take up any portion of the £15,000,000.

The Chairman said although the Committee was not an investors' protection association, yet they had instructions to safeguard the future of the line, and they would like to see the agreement scheduled in the Bill.

Sir R. Littler thought there would not be time to arrange such a schedule.

Mr. Yerkes: Anything that you gentlemen require to secure the financial part of the undertaking, you shall have.

The Committee adjourned till Wednesday.

Mr. Seale Hayne's Tube Committee.

On Thursday last week a Select Committee of the House of Commons, presided over by Mr. Seale Hayne, commenced the consideration of a number of Bills for the construction of tube railways in London. The other members of the Committee are Mr. Tennant, Sir J. Stirling Maxwell and Mr. Lowe. The first Bill considered was that of the Great Northern and City Railway, and, in opening the case for the company, Mr. Moon, K.C., explained that the railway was authorised in 1892. At that time and now the Great Northern Railway had very great difficulty in dealing with their suburban traffic, so far as getting into the City was concerned. As showing the amount of the traffic, he might say that no less than 30 millions of people per annum passed through Finsbury Park Station, and the passengers to be carried were increasing at the rate of one million per annum. When the Bill was promoted in 1892 the idea was to have a railway from Finsbury Park to Finsbury Pavement, and it was intended that the Great Northern Company's trains should run right through from the suburbs by a connection at Finsbury Park to the City. At that time, however, the public had little confidence in tube railways. The only one in operation was the City and South London, which was paying a very small dividend, and consequently it was found to be impossible to raise the money for the construction of this line. In 1898 a new and strong board was formed, of which Sir Charles Scotter was the chairman, and Lord Lauderdale, Sir Henry Burdett, Sir Francis Knollys and Sir Allen Sarle members, and a fresh application was made to the public and the necessary capital was subscribed. The line was in course of construction, and was almost completed, and the only reason why it had not been completed between Drayton Park and Finsbury Park was that the Great Northern Railway Company now considered that the proper solution of getting their traffic through to the City was not by exchanging a locomotive for an electric motor on their trains, but by having an exchange station at Finsbury Park. Accordingly, the plans for the lines had had to be changed,

and the Great Northern Company had now got power, in conjunction with the Great Northern and City Company, to make a connecting link between Drayton Park and Finsbury Park, and the work was now in progress. The Committee might, therefore, take it that this was a railway on the point of being in operation between Finsbury Park and Finsbury Pavement. When, however, the new board came to consider the question of the prospect and of the future of the line, they came to the conclusion that the terminus was not in the proper place—that it was too far from the centre of the City, and therefore they had promoted this present Bill, the main object of which was to project the line to a station at Lothbury, close to the Bank of England. That short prolongation would be very costly, but the board believed that it was financially worth while to do it. The other object of the Bill was to ask for an extension of time for the construction of the works. It was also proposed to make an additional station at Highbury for the convenience of local traffic and at the request of the district, and to acquire land for a generating station for generating the electricity necessary to work the line. Those objects were not now opposed, but the extension to Lothbury was. Originally, the Bank of England and several insurance companies opposed the extension, but that opposition had been withdrawn since the acceptance of the vibration clause for the protection of landowners, which had been drawn up by Lord Windsor's Committee. The only opponent to the extension now was the Corporation of London, who, in a petition containing 31 clauses, raised every conceivable objection against the railway. Their principal point was that the company proposed to take the subsoil of the streets, and the City Corporation said that such subsoil belonged to them. He did not think the Committee would uphold that contention in the face of the report of Lord Cross's Committee of 1892, who reported that, in the case of public streets, they thought it expedient that companies should be allowed to pass under streets at sufficient depth without payment of compensation if they provided cheap and convenient trains. That the company had already agreed to do at the desire of the London County Council, and, therefore, he held that the objection of the Corporation did not hold good.

Sir Charles Scotter gave evidence in favour of the Bill. He said that the whole of the necessary capital had been raised, and no doubts could be cast upon the *bond fides* of the scheme. It was proposed to have subways connecting the four exits at Lothbury with the surface, which would be a great convenience for foot passengers. He was surprised at the claim set up by the Corporation of the City for compensation for the use of the subsoil.

Sir Henry Oakley, Mr. Barkey, M.P., Mr. Claude Hay, M.P., and others having given evidence in favour of the Bill, Sir Douglas Fox spoke as to the engineering features of the scheme, and said he was instructed to say that the promoters would be willing to do anything within reason to meet the views of the Corporation, but they did not think it reasonable that they should be asked to pay for the use of the subsoil.

Mr. Vesey Knox, who appeared for the City Corporation, examined Mr. A. C. Morton, C.C., who detailed the objections which the Corporation had to the proposed extension. He said that if Parliament sanctioned the Bill, the Corporation would advance a claim for compensation for the use of the subsoil and for the surface area taken from the public.

The Chairman said he thought the matter in dispute between the company and the Corporation was one that ought to be settled by a friendly agreement, and in the hope that this might be done the further hearing of the Bill was adjourned.

On resuming on Friday, Mr. Acworth stated that the promoters admitted that they should pay where they took a permanent occupation of a portion of Princes Street, and were prepared to make that clear in the Bill.

Sir Ralph Littler, K.C., said that was not clear in the Bill, and was not sufficient. He thought the admission of his learned friend destroyed the case of the promoters. He should be perfectly satisfied if the Committee could not only do what he asked for, but could also assess the amount to be paid, in order that the whole matter could be settled at once, but they unfortunately could not do that. He contended that when the promoters constructed the railway, and came to the surface, cutting it up, and so obstructed the traffic, they should pay compensation for it. The Corporation had not asked anything for Moorgate Street, but had said that when anything of material value was taken for private gain, a payment should then be made as an arbitrator or jury might determine. The promoters had offered to construct two subways at Princes Street, which were not required, as the roadways were only 27 ft. wide in one case, and 30 ft. in the other.

Mr. Acworth said the promoters had simply followed precedents in their Bill. The clause contained in the Bill was in all the "Tube" Railway Acts. He admitted that when they reached the surface the case was different, but they claimed power to take the subsoil.

The Chairman announced that the Committee found the preamble proved.

Dealing with the clauses, Sir R. Littler wished to add to clause 4, the words "Nothing in this section shall authorise the company to take lands, if any, vested in the Corporation within 30 ft. of the surface without paying compensation under the Land Clauses Act."

The Committee, however, rejected the addition, and the remaining clauses having been adjusted, the Bill was ordered to be reported to the House.

On resuming on Monday, Mr. Talbot, K.C., on behalf of the London County Council, asked the Committee not to sanction the proposal of the Charing Cross, Euston and Hampstead Companies for a terminal station, as contained in the Bills, on the ground that it would have the effect of reducing the width of the Strand at that point by 67 ft. It was the desire of the County Council and the Corporation of Westminster that the width should be 80 ft. He pointed out that the South-Eastern Railway were under an obligation to not materially reduce the width of their station yard at Charing Cross.

Mr. A. Young, the County Council valuer, said that the Council had spent some 2¼ millions in widening the Strand, and they were now in communication with Messrs. Coutts' to see whether they would agree to set back the property in the middle of the block scheduled for widening. Unless the thoroughfare was widened at this point, the present congestion of traffic in the Strand would be added to by the proposed station. Opposite the site for the proposed station a slight concession had been obtained from the South-Eastern Company, but negotiations with Messrs. Coutts in reference to the rebuilding of the Lowther Arcade had not yet resulted in any arrangement. He was prepared to admit that the refusal of the proposed site would put the promoters to some inconvenience, but after all that difficulty could be got over by the engineers. The general public convenience should be of primary importance with the Committee in any decision they might give.

Mr. Balfour Browne, K.C., who appeared for the Piccadilly and City Railway Company, said that his clients withdrew their opposition after an arrangement for a joint station had been come to. He would like to know if the under surface of the road would be given to the companies for the station. If that were done, there would be sufficient room.

The Chairman said the Committee were of opinion that the 80 ft. width in the Strand should be preserved. He thought that Mr. Balfour Browne's suggestion as to the under surface of the roadway would be a good solution of the difficulty. The engineers could arrange matters on those lines.

Mr. Talbot intimated that the County Council were in favour of a joint station, and there would be ample space for it if the office of Woods and Forests would consent to the companies taking land on arbitration terms.

Mr. Talbot next urged the Committee to strike out the provision in the clause relating to fares which limited the compensation the company might have to pay to holders of workmen's tickets meeting with an accident, to £100. He submitted that the clause was quite unreasonable, as no claim could arise except in the event of proved injury through the neglect of the company. He reminded the Committee that the Joint Committee of 1901, on the subject of workmen's trains, recommended some modification of the clause.

Mr. Clode said he hoped the Committee would let the clause stand as it was. A similar clause appeared in every tube railway Act, and had become an established practice in Parliament.

After deliberating in private for a short time, the parties were re-admitted, when the Chairman said the Committee had decided to pass the clause as it stood. They, however, desired him to say that they did so, because it was in accordance with precedent, and they did not wish their action to be taken as having expressed an opinion on the merits of the general question.

The remaining clauses were then adjusted, and the Bill was ordered to be reported to the House.

The North-West London Railway.

This Bill should have come before the Committee, but all opposition having been withdrawn, it was removed from the group and passed the Chairman of Ways and Means on Monday as an unopposed measure.

Charing Cross, Euston and Hampstead Railway Bill.

Mr. Freeman, K.C., opening the case for the promoters of this Bill, said it was proposed to extend the authorised line to Golder's Hill from Hampstead, where there would be an end on connection with the Hampstead and Edgware line, and also to extend the line at Kentish Town to Highgate. No objection had been raised to the proposals, except by some of the inhabitants of Hampstead who feared that a tunnel under the Heath would be detrimental to the surface. The promoters would not put any shafts or openings on the Heath, and the L.C.C. and Hampstead Council were satisfied that at a depth of 200 ft. no injury would be caused to the Heath.

Mr. Galbraith, C.E., gave evidence, and stated that as far as the engineering part of the scheme was concerned, there was no difficulty at all. It was perfectly possible to construct the tunnel at such a depth in the London clay, that no possible injury would be caused to the Heath.

Sir Alex. Binnie also gave similar evidence.

Mr. Figgis, chairman of the committee of residents of Hampstead, maintained that the tunnel would damage the Heath, and by the draining of the subsoil there would be a risk of damage to the vegetation. It was feared that at some future date Parliament might be unable to refuse the demand that would be made for the better ventilation of the underground railways, and then ventilation shafts would have to be constructed on the Heath.

Mr. Galbraith denied that there would ever be any intention to put up ventilating shafts on the Heath, and said there would be no difficulty in ventilating the tunnels with fans.

The Committee afterwards found the preamble proved.

Great Northern and Strand Railway Bill.

The Chairman of Ways and Means reporting from the Committee on the Great Northern and Strand Railway Bill, states that the railways authorised by the Great Northern and Strand Railway Act, 1899, were intended to commence at the Great Northern

Railway Company's Wood Green station, and to extend southward to the Strand. It is proposed by the Bill to construct a deviation railway, the intention being that the northern terminus of the line shall be at the Finsbury Park station of the Great Northern Railway instead of at Wood Green. The works connected with the station at Finsbury Park referred to as the station section of deviation railway are proposed to be constructed by the Great Northern Railway Company. It is proposed by the Bill to authorise the abandonment of Railway No. 1 and a portion of Railway No. 2 authorised by the Act of 1899, and the application to the deviation railway (other than the station section) of a portion and the release of the balance of the money deposited in respect of the railway and portion of railway to be abandoned. That in pursuance of Standing Order No. 158A a report from the Board of Trade had had been referred to the Committee. Such report after setting out the circumstances of the case stated that the Board of Trade had no special information as to the effect on the traffic of the district concerned, which would be produced by the abandonment of the authorised Railway No. 1, but that subject to this observation the board saw no reason why the proposals contained in the Bill as to abandonment and repayment of deposit should not receive the favourable consideration of the Committee. It was explained to the Committee that the reason for the proposed alteration of the scheme was that the Great Northern Railway Company had decided to make Finsbury Park the exchange station between the Great Northern system and the Great Northern and Strand and Great Northern and City Railways, and the Committee were satisfied that the change would be in the interest of the public, and that the traffic of the district concerned would not be injuriously affected thereby, and they therefore recommend that the proposed abandonment and release of deposit money should be allowed. It is proposed by the Bill to extend the period limited by the Act of 1899 for the completion of such portion of the works thereby authorised as is not proposed by the Bill to be abandoned (except a short length of railway, the construction of which is dependent on the making of a new street) and to extend the provisions of that Act so as to enable the promoters to pay interest out of capital, within the time limited by the Bill, for the construction of the deviation railway. The Committee consider that under the circumstances the power so sought is reasonable, and they have allowed the same. In pursuance of the instruction of the House on July 16th, the Committee had inserted in the Bill provisions making the legislation as to cheap trains contained in the Brompton and Piccadilly Circus Railway Bill applicable to the railways between Brompton and King's Cross in the event of the railways forming part of a through route between those points, and providing for the railways from Finsbury Park to Brompton being in the aforesaid event treated as one railway for the purposes of the Cheap Trains Act.

Edgware and Hampstead Railway.—On Thursday last week this Bill came before the Unopposed Committees of the House of Commons, and was ordered to proceed. It authorises the construction of a tube railway from Edgware to Hampstead.

Great Northern and Strand Railway Company.—This Bill which authorises the alteration and extension of the Great Northern and Strand Railway and the transfer to the Brompton and Piccadilly Railway Company, was last week before the Unopposed Committee of the House of Commons, and the preamble was declared proved.

Nottingham Corporation Bill.—Last week this Bill passed the House of Commons as an unopposed measure.

North Staffordshire Tramways.—The Chairman of Ways and Means in the House of Commons last week had the above Bill before him as an unopposed measure, and, formal evidence having been given, the preamble was declared proved. It empowers the North Staffordshire Tramway Company to work tramways electrically in connection with the Potteries Electric Traction, Limited.

Swansea Corporation Bill.—The Select Committee of the House of Commons, presided over by Mr. Heywood Johnstone, has passed the preamble of this Bill, which gives power to borrow £21,000 for the construction of tramways, and £153,185 for the purchase of land for, and the extension of, the electric lighting station.

Baker Street and Waterloo Railway.—This measure came before the Chairman of Ways and Means in the House of Commons on Monday, and was ordered to go forward, there being no opposition.

Edgware and Hampstead Railway.—In his report to the House of Commons on this Bill, the Chairman of Ways and Means states that a report from the Board of Agriculture was submitted, but the powers as to the construction of the railway under part of Hampstead Heath had been struck out. Further, that the Committee had, pursuant to an arrangement stated to have been made by the promoters, altered Clause 55 of the Bill, by reducing to one-half the special fares proposed to be charged for workmen, and the Committee considered by so doing, they had sufficiently complied with the instructions of the House on August 1st.

Saddleworth, Springhead, and Lees Tramways.—This Bill, which has already passed as an unopposed measure in the House of Lords, was, on Monday, before the Unopposed Committee of the Commons, and was ordered to be reported for third reading.

Pontypridd Tramways.—A Select Committee of the House of Commons, presided over by Mr. Ashton, was on Thursday and Friday last week engaged in the consideration of the Pontypridd Tramways Order contained in the Tramways Provisional Orders Confirmation (No. 2) Bill. The order authorises the Urban District Council to construct an extension of the present tramway system.—Mr. Ram, who appeared for the promoters, said the present proposal was to a large extent promoted to carry out the extension of a scheme which found favour with two Committees of Parliament last session. The local authority was unanimously in favour of the Bill, and the chief opposers were the Taff Vale Railway, who objected that the tramways would be a serious competitor to them. There were also petitions from frontagers, who alleged that certain streets were not wide enough to accommodate the tramways.—Mr. Vesey Knox, representing the Glamorgan County Council, said that they had come to terms with the Urban District Council, and had agreed to withdraw opposition on condition that the District Council did not oppose any subsequent application by the County Council for running powers on reciprocal terms.—A number of local witnesses were called in favour of the Bill, and several frontagers gave evidence in opposition.—Mr. Balfour Browne addressed the Committee in opposition to the Bill on behalf of the Taff Vale Railway, but called no witnesses. The Committee adjourned till Tuesday, when, further evidence having been heard, the order was confirmed.

Royal Assent.—The Royal Assent has been given to the following Acts:—

Electric Lighting Orders Confirmation (No. 1) Act, 1902.
Rothesay Tramways (Extension) Order Confirmation Act, 1902.
Bradford Corporation Act, 1902.
Northumberland Electric Tramways Act, 1902.
South Wales Electric Power Distribution Company Act, 1902.
Newcastle-upon-Tyne Corporation Tramways Extension Act, 1902.
Kent Electric Power Act, 1902.
Leicestershire and Warwickshire Electric Power Act, 1902.
Tyneside Tramways and Tramroads Act, 1902.

London County Council (Tramways and Improvements) Bill.—This Bill came before a Select Committee of the House of Lords, presided over by the Earl of Yarborough, on Monday, Tuesday and Wednesday last week. The Bill contains proposals for 11 different sections of tramways in the Hammersmith, Fulham, Woolwich, Eltham, Camberwell, Denmark Hill, and other districts.—Mr. Erskine Pollock, K.C., represented the L.C.C., and in his opening statement said that the only opposition was directed to two sections of tramways, which were numbered 5 and 15 in the Bill. In the case of No. 5 tramway, it was proposed to start at Hammersmith Broadway, and proceed *vid* Fulham Palace Road, over Putney Bridge, and end in the Lower Richmond Road; this tramway was 2 miles 5 chains long, and would be worked on the underground conduit system. No. 15 tramway commenced with a junction with the existing line in Camberwell Road, would go *vid* Denmark Hill and Grove Lane and end in Lordship Lane. The line was proposed on the suggestion of the Camberwell Borough Council. The only opposition came from frontagers and property owners on the general grounds of depreciation to the value of property.—Mr. J. W. Benn, chairman of the Highways Committee of the County Council, bore out the Council's opening statement, and denied that electric tramways tended to depreciate the value of property. On the contrary, he held that such lines were not so noisy or dirty as omnibuses.—Mr. Baker, the tramway manager, said the conduit system would be employed on the two tramways objected to, and he was of opinion, from his observations in the United States and Canada, that this system caused much less noise than the overhead system. With regard to the speed at which the cars would run, this would be controlled by an inspector of the Board of Trade, who would examine the lines. With reference to the steep gradient of Dog Kennel Hill this presented no difficulties for electrical traction. That scheme was rejected by the House of Lords last session at the instance of the East Dulwich Tramway Company, who opposed, but the cars of that company had ceased to run. With regard to the tramway over Putney Bridge, that was an instalment of a larger scheme, and it was hoped there would be a junction with the London United Tramway system.—Local evidence was then called for Camberwell and Fulham in support of the Bill.—Mr. Bull, M.P. for Hammersmith, expressed the opinion that the present communication between Putney and Hammersmith was very inadequate, and he welcomed the scheme of the Council. Similar evidence was given by Mr. T. Davies, the Mayor of Fulham.—Mr. Young, the L.C.C. valuer, said the estimated cost of acquiring property for the Fulham scheme was £120,026, but they expected £93,000 to be recouped from the subsequent sales of land. The cost of property for the Dulwich scheme was £78,900, with an expected recoupment of £5,000.—Evidence was called for the Dulwich district in opposition to the Bill on the ground that the property would be depreciated and the wealthier inhabitants leave. Counsel having addressed the Committee, the chairman announced that the Committee had unanimously decided that the preamble of the Bill was proved.

Leeds Corporation Tramways.—The Order, contained in Tramway Order (No. 2) Bill authorising the Corporation of Leeds to construct additional tramways in their city, came before Mr. Ashton's Select Committee of the House of Commons on Thursday last week. In all about six miles of tramways were proposed under the Bill. Mr. Shaw who, with Mr. Moon, appeared for the London and North-Eastern Railway Company, asked that where the tramways proposed to cross a bridge of the company, the tramway authority should be made liable to pay the cost of any strengthening of the bridge which might be necessary, and he also submitted that should any interference take place in the running of the tramway by reason of the bridge having to be altered or strengthened, the railway company should not be liable to pay any compensation. Mr. Balfour Browne, K.C., contended that the road was in existence when the railway came, and the railway company built the bridge for their own convenience, and were compelled to maintain it for all time. The railway company were bound to make the bridge strong enough to carry all traffic which might lawfully have been carried on the road which was in existence before the bridge was made. The Committee held that the railway company were sufficiently protected by the Order as it stood, and overruled the objection, and the Order will accordingly proceed.

London United Tramways Bill.—On Wednesday last week, a Select Committee of the House of Lords, presided over by the Earl

of Yarborough, commenced the consideration of this Bill, which seeks to confer further powers on the London United Tramways Company for constructing tramways and widening roads in the counties of London, Middlesex and Surrey. Mr. Balfour Browne, K.C., appeared for the promoters, and explained that the Bill when originally introduced, asked for power for the company to construct about 15 miles of tramway to be worked on the overhead trolley system of electric traction. When, however, the Bill was before the House of Commons Committee, one small line was struck out on the opposition of Wimbledon frontagers, while the suggested line over the Hammersmith Suspension Bridge was struck out at the instance of the London County Council, who contended that the bridge was not strong enough to carry the proposed tramways. A pledge was, however, given that the London County Council would come before Parliament, and ask for powers to construct a bridge which would be capable of bearing a tramway. With regard to the three short lines to be constructed in Hammersmith, an agreement had been come to with the London County Council, by which the Council would have power to purchase the lines at a given date. There was at present a horse tramway between Kew and Richmond, but this would be reconstructed for electrical traction. From Richmond the tramway would be carried through Mortlake and Barnes by the river to Hammersmith, and the consent of the local authority had been obtained to this, although certain frontagers had petitioned against the line. It was also proposed to connect Malden with Wimbledon, and with the London County Council's system at Tooting. The present system of the company covered 46 miles, of which 16 miles were worked by electricity. There was practically no opposition from the local authorities, who had safeguarded the interests of the ratepayers, and had imposed obligations on the company with respect to widening certain roads. In fact, the total cost of the improvements which the company had undertaken to carry out was £338,000. As to the question of purchase by the local authorities, agreements had been made whereby the company paid certain sums to the local authorities for extensions of the periods. Evidence was given by Mr. J. Clifton Robinson in support of the scheme. He considered the overhead system a more useful and successful system than the conduit system. Mr. Benn, the chairman of the Highways Committee of the London County Council, had, so far as he was able to do so, pledged the Council to apply to Parliament next year for power to construct a new bridge at Hammersmith, and to run a tramway over it. Mr. E. J. Halsey, chairman of the Surrey County Council, Mr. Howell, surveyor to the Surrey County Council, and Mr. Barton, chairman of the Highways Committee of Barnes Urban District Council, gave evidence in support of the Surrey proposals. Mr. Skewes Cox, M.P. for the Kingston Division of Surrey, said the local authorities in the constituency were in favour of the tramways from Richmond to Hammersmith. Mr. C. J. More, engineer to the Thames Conservancy Board, gave evidence as to the river embankment the company would construct at Barnes at a cost of £30,000. This would, he said, make no difference to the flow of the river. The Thames Conservancy had given a license to the company. Mr. Humphreys, a member of the Tramways Committee of the Richmond Town Council, said the feeling of the locality was overwhelmingly in favour of the proposed lines. Mr. Thompson, a member of the Richmond Town Council, gave a number of statistics showing the fares charged at present by the railway companies. Mr. Bond, a member of the Wimbledon Urban District Council, said the lines proposed in Wimbledon would be very advantageous to the district, and would give a route to Malden and Kingston. A great deal of local evidence was called for the Wimbledon district, all the witnesses speaking in favour of the scheme, especially as affording facilities to the working classes. This closed the case for the promoters, and it was stated that the Malden and Coombe District Council had withdrawn opposition on the promoters undertaking to widen the road at the Norbiton Park Hotel, and thus remove the inconvenience of the sharp curve there.

On Friday Lord R. Cecil, K.C., withdrew the opposition of frontagers to the Wimbledon tramways, but addressed the Committee on behalf of frontagers in opposition to the Barnes and Hammersmith sections. A number of witnesses were called, who held that the proposed tramways would depreciate property. The Committee found the preamble of the Bill proved, and ordered it to be reported to the House for third reading.

Saddleworth, Springhead and Lees Tramways.—This Bill, which incorporates the Saddleworth and Springhead Tramways Company and authorises the construction of tramways in Saddleworth, Springhead and Lees of a length of about 14 miles, came before a Select Committee of the House of Commons, was ordered to be withdrawn from the group and referred to the Unopposed Committee.

Baker Street and Waterloo Railway.—It is announced that all opposition to this Bill will be withdrawn, and it has been referred to the Unopposed Committee. The Bill authorises an extension of time for the completion of works.

Garston and District Tramways and Electric Supply (Transfer) Bill.—Last week this Bill was before Earl Morley in the House of Lords as an unopposed measure, and was ordered to go forward for third reading.

Tramways Orders Confirmation (No. 1) Bill.—This Bill was before the Chairman of Ways and Means in the House of Commons last week as an unopposed Bill and was ordered to go forward. The measure confirms Orders granted by the Board of Trade to Brighton, Cheadle and Gatley, Lees, Southport, Stockport and Sunderland.

LEGAL.

Electric Tramways Construction and Maintenance Company, Limited, v. Rutterford.

In the Chancery Division of the High Court of Justice on Friday, Mr. Justice Buckley had before him a motion on behalf of the defendant that all proceedings in this action might be stayed upon terms of a certain agreement that had been entered into in terms of the notice of motion.

Mr. Buckmaster, K.C., in support of the motion, stated that the action was brought against Mr. Rutterford to obtain specific performance of certain agreements relating to electrical construction. The action was in the paper for hearing before Mr. Justice Byrne on July 7th, and certain terms were agreed between Mr. Rutterford and two gentlemen, who, it was said, had power to act on behalf of the company, namely, Mr. Harry Lawson and Mr. Osborne. It was now denied that either of those gentlemen had any authority to bind the company. Mr. Harry Lawson was not a director, and Mr. Osborne was merely the secretary. Proceeding, the learned counsel stated that his evidence was not in a position at present to enable him to move the motion effectively. Therefore, he asked that the motion should stand till the trial, when he could cross-examine these gentlemen, and ascertain whether the terms of agreement were communicated to the company, and were adopted. If he showed that that was the case, the action would have to be stayed.

Mr. Astbury, K.C., for the company, said he was quite willing to facilitate the matter, provided costs were reserved.

His Lordship ordered the motion to stand till the trial of the action.

Rossall *v.* Blackpool, St. Annes, and Lytham Tramway Company.

Arising out of an electric car accident, the Blackpool, St. Annes, and Lytham Tramway Company were sued at Blackpool County Court on July 23rd by J. Rossall for damages for injury to a horse. It appeared that on May 29th one of the company's cars collided with plaintiff's horse, severely injuring it. Judge Coventry, in awarding the plaintiff £32 2s, said that possession of a certain part of the road belonged to the tramcars, and other traffic must make way for them. The company, however, had no right to expect horses to be whipped up to get out of the way of the trams. Roads, he added, were not made for trams, but for the ordinary traffic of the country.

Electric Lamp Regenerating Company, Limited.

Mr. Justice Buckley, sitting in the Chancery Division of the High Court of Justice on Friday for the disposal of company business, had before him a petition by Howard & Jones for the winding-up of the Electric Lamp Regenerating Company, Limited.

Mr. Whinney, however, stated that a scheme of reconstruction had been proposed, and 55,000 out of 80,000 shareholders, at a meeting on the Friday previous, approved it in principle. The scheme provided for further capital, and a sum was subscribed which was sufficient to cover the claims of creditors. Mr. Milne, the chairman, would give his personal undertaking to pay the creditors.

His Lordship ordered the petition to stand over to see if the undertaking was carried out.

BUSINESS NOTES.

American Electrical Exports.—The value of the electrical goods and apparatus exported from the United States during May last is returned at £181,545, a decrease of £9,369 as compared with the corresponding month of 1901. By far the largest quantity was shipped to England.

Exhibition.—The third annual Ironmongery, Hardware and Electrical Trades Exhibition and Market, is to be held at the Agricultural Hall, Islington, from August 12th to 22nd.

Meeting Called.—A meeting of stockholders of the Blackpool Electric Tramways (South), Limited, is to be held at Liverpool, to consider their position. The meeting is called by the trustees under the Debenture Stock Trust Deed.

Nernst Lamps on the Canadian Arch.—We understand that the coming illumination of the Canadian Arch will again be chiefly executed with Nernst lamps. The Electrical Company, Limited, which has secured the order also for the illuminations on August 9th, 10th and 11th inst., is endeavouring to make this display a most brilliant spectacle of effective illumination. On the night of June 30th, the London public saw for the first time an illumination executed with Nernst lamps, but this time the Electrical Company, Limited, is going to use about double the number of these lamps before employed, and a very remarkable effect should be produced. It is stated that after the first successful show of Nernst lamps, the company received large orders for them.

Electrical Wares Exported.

Week ending July 30th, 1901.		Week ending July 29th, 1902.	
Adelaide	Value £16	Alexandria. Teleg. mat.	Value £580
Amsterdam	90	Buenos Ayres	1,708
Buenos Ayres	288	Calcutta	1,462
,, Teleg. wire ..	820	,, Teleg. instruments..	1,053
Calcutta	678	Cape Town	41
Cape Town	801	Christchurch	141
,, Teleg. sundries ..	488	Christiania. Teleg. wire ..	45
Chefoo. Teleg. mat.	37	Colombo	3,932
Chinde. Teleg. mat.	122	Copenhagen	3,080
Colombo	60	,, Teleg. mat. ..	78
Copenhagen. Teleg. mat. ..	88	Durban	522
Demerara. Teleg. mat.	182	,, Teleg. mat.	1,362
Durban	588	Fremantle	80
East London	289	Grenada. Teleg. mat.	86
Flushing	116	Hamburg. Teleg. cable ..	25
Gottenburg	12	Hong Kong..	158
Hong Kong. Teleg. apparatus	40	Larache	824
,, Teleg. mat. ..	83	Madras	7
Lyttleton	32	Melbourne	147
Madras	749	Nagasaki	70
Malta	246	Naples	210
Marseilles. Teleg. mat. ..	145	Ostend	870
Melbourne	583	Perth	1,061
Ostend	100	Port Elizabeth	1,500
Rangoon	40	Rotterdam. Teleg. wire ..	85
Perth	905	Shanghai	174
Port Said	20	Sydney	376
San Francisco	42	Tientsin	39
Shanghai	71	Valparaiso	49
Singapore	47	Vera Cruz	8,635
Sydney	2,429	Yokohama	106
,, Telephones	41		
Valparaiso	74		
Vera Cruz	39		
Wellington	225		
,, Teleg. mat... ..	78		
,, Telephones.. ..	1,790		
Yokohama	126		
Total ..	£11,241	Total ..	£27,801

Foreign Goods Transhipped.

Cologne. Teleph. cable.	Value £278	Gothenburg. Elec. appar.	Value £15
Durban. Elec. mat.	123		
Gothenburg. Elec. apparatus..	13		
Madras. Elec. car parts ..	76		
Total ..	£490		

Bankruptcy Proceedings.—The public examination was held last Tuesday at the London Bankruptcy Court before Mr. Registrar Linklater, of A. J. Sanderson, lately managing director of the Electrical Inkless Printing Syndicate, Clifton Mansions, Coldharbour Lane, Brixton. The debtor applied to pass upon accounts showing a deficiency of £18,602. In the course of his evidence, he stated that he and a brother formed the syndicate in September, 1898, with a capital of £60,000. They held the patents, under a contract to purchase them, from Mr. Green, of Dovercourt, at the price of £15,000, which was paid as to £3,000 in cash, and £12,000 in shares. The patents were resold to the syndicate for £60,000, which they received as to £4,000 cash, and £56,000 in shares. Witness handed over his £24,000 vendors' shares to his wife. He was appointed managing director without salary, and held the office until he resigned in September, 1901. He was brought to the Court on the petition of Mr. E. Toppin, who claimed £4,500, under a commission note given him by witness for obtaining the introduction to Mr. Green. The debtor was examined regarding certain building speculations in which he had been interested, and was ultimately allowed to pass. Mr. F. Cooper Willing appeared on his behalf.

A first and final dividend of 2s. 0½d. is to be paid in *re* G. J. Lloyd (G. J. Lloyd & Co.), electrical and mechanical engineer, of Bristol.

Liquidation.— Imperial Electric Supplies, Limited, of Charing Cross Road, has resolved to wind up voluntarily with Mr. E. P. Harvey as liquidator.

Books Received.—"Annual Calendar of McGill College and University," Montreal. Session 1902—3. Montreal: The University. 1902.

"La Traction Electrique par Contacts Superficiels du Système Diatto," by Ch. Julius. Paris: Gauthier-Villars. 1902. 2 fr. 75 c.

"Proceedings of the Thirty-fifth Annual Convention of the American Institute of Architects, 1901." Washington: By the Board of Directors.

"British Trade and the Zollverein Issue," by L. G. Chiozza. London: The *Commercial Intelligence* Publishing Company. 1902. 1s. net.

"The Scientific Writings of the Late G. F. Fitzgerald," by Joseph Larmor. London: Longmans, Green & Co.; Dublin: Hodges, Feggis & Co., Limited. 1902. 15s.

"Science Abstracts," July 25th, No. 55. London: The Feilden Publishing Company, Limited. 2s.

"Sur les principes fondamentaux de la Théorie des nombres et de la Geométriè," by H. Laurent. Paris: C. Naud. 1902.

Catalogues and Lists.—Mr. A. G. Thornton, of Manchester, has sent us his price list of the "Nerite" adjustable board and square, which seems to be a capital piece of apparatus for the drawing office. It can be fixed at any height, vertical or horizontal, or at any required angle, and the square is counterbalanced; the whole thing is very portable, constructed of good materials and comparatively inexpensive.

We have received from Messrs. Duncan Campbell & Son, Glasgow, a box of sample "Century" document bands, a clever and simple device for instantly fastening together a bundle of papers, which can with equal readiness be released.

Messrs. Cole, Marchent & Morley, Ltd., of Prospect Foundry, Sheffield, have issued a very complete catalogue of their condensing equipments. The book is excellently arranged, and contains many illustrations, including a number of views of the works. The letterpress describes a few of what are considered the best condensing and cooling plant arrangements, and a good list is given of corporation electrical and other works for which condensing plants have been supplied recently or are now in hand. Some "notes on condensing plants, heaters, evaporators and cooling plants for steam power installations," which occupy nine pages, consider the question of the most suitable type of plant for certain purposes. These are followed by descriptions and pictures, among them a number of diagrammatic sketches of different parts of condensing equipments and many auxiliary appliances. A number of views appear of the Stockwell generating station of the City and South London Railway, showing the lay-out of this firm's engines and condensing plant thereat. We have no doubt that many of our readers will be anxious to have a copy of this small book in their possession.

Messrs. Crompton & Co., Ltd., of Chelmsford, have brought out a list, in which they describe and show their new "SS" type of double-carbon arc lamps. The "S" type single-carbon lamp is said to have achieved a great success, hence the introduction of the "SS" lamp, which is being offered in two sizes, known as "SS short" and "SS long." The mechanism of the lamp is of the differential type, except in a few special cases, the principle of it being the same as that of the "S" type single-carbon lamp, but the arrangement of parts has been modified to meet the special requirements of the duplicate feed. The lamp has few working parts, and these are readily accessible. The moving parts are balanced, and the design of the mechanism enables the most delicate feed to be maintained throughout the whole of the burning hours. The lamps focus correctly, and the distance between the two pairs of carbons is reduced to a minimum. Both poles of the lamp are, moreover, insulated from the frame and case. The lamp is supplied for continuous and alternating circuits.

The Electrical Co., Ltd., have just issued lists Nos. 10, 13 and 15; 10 is devoted to accumulator apparatus; 13 to lightning arresters and sundry safety devices, and 15 to measuring instruments. Each list has a convenient thumb index to the different sections, and all of them are fully illustrated.

Dialite Cables.— In February last Mr. Wordingham reported on a cable manufactured by the St. Helens Cable Company, Limited, insulated partly with paper, and partly with a material known as dialite, and his results were published in the Electrical Review for February 21st, 1902. This cable may be said to have been insulated with paper and the paper protected from moisture with the dialite, although as was shown in that report, the dialite was itself an insulator. On June 20th he made tests on other cables in which dialite was employed as the dielectric, paper of a relatively small thickness being only used next to the wire, and in one of the cables the paper was omitted altogether. Dialite, we may add, is a vulcanised substance of the greatest durability, the raw material called bitumen having been in successful use for many years. It is purified by a special process on the latest scientific basis. The tests showed that all the cables have a satisfactory insulation resistance whether they be intended for underground work or for house wiring. The tests of the dielectric strength, however, are far more important than the insulation resistance, and the results attained were most remarkable. That a wire so small as 7/22's should withstand for half-an-hour, without breaking down, a pressure of between 1,800 and 1,900 volts, shows exceptionally high dielectric strength, and seeing that there was no paper at all on this sample, it shows conclusively the valuable properties of dialite. The bending test of the large cable, *i.e.*, 37/12, was also a severe one, and speaks well for the mechanical strength of the material. The series of tests carried out, however, in connection with the house wires are, to Mr. Wordingham's mind, the most satisfactory evidence as to the mechanical properties of the material. The conditions were severe, and were just those to which cables would be likely to be subjected in practice. In conduit systems of house wiring, cables are very frequently drawn round bends in the tubing, and it is no uncommon thing to pull them through holes bored in joists. The knotting of the cable imitates well the kink which is so often put into a cable by a careless wireman. After being subjected to this treatment, the wires, in every case, stood 10,000 volts, and did not break down until between 15,000 and 18,000 volts had been applied. Mr. Wordingham's conclusion is that so far as can be judged by experiment, wires insulated with dialite appear to be of good insulation resistance, of high dielectric strength, and even without the additional protection of braiding or taping, very strong mechanically. Not only, therefore, should they be well suited for underground mains, but also for the interior wiring of premises.

The E.L.B. System.—The Electric Lighting Boards Company contributed to King Edward's Hospital Fund by undertaking the entire illumination of the Crystal Palace transept on the occasion of the great Empire Ball, and at the same time did some record work so far as time was concerned. The installation comprised 2,200 lights, worked in the form of an enormous velarium over the centre of the transept, and in outlining the galleries and Royal Box in festoons. The lights and festoons were covered with artificial flowers, and the number of connections required some two miles of cable, as the distance from the supply source was considerable. The whole of this work was executed in three days of ordinary working hours by three men and two boys under the supervision of the foreman, including the garland work and very difficult fixing at great heights. We understand that the effect was so

artistic that the Crystal Palace authorities retained the work for the American Festival, and some well-known caterers propose taking over the whole of the installation.

Electricity in Coal Mining.—On the 12th ult. the members of the North of England Institute of Mining and Mechanical Engineers had a meeting at Bishop Auckland, Durham, in order to inspect, at the invitation of the owners, South Durham Colliery, where there is an extensive electrical plant. The installation was put in really on the grounds of economy, coupled with efficiency, and consists of powerful pumps and coal-cutting machines. The pumping plant consists of a continuous current generator, steam driven, two electric motors, and two ram-pumps. The current is obtained from a Scott & Mountain six-pole generator. The main shaft pumps have rams 11 in. in diameter × 18 in. stroke, capable of delivering 500 gallons per minute to a height of 400 ft. The coal-cutting machines, five in number, are of the Goolden bar type, which are driven by motors. This latter plant was erected by the Electrical Coal Cutting Contract Corporation, and the cutting was done at a fixed price per ton, but the plant was afterwards bought by the South Durham Coal Company. The visitors were entertained to luncheon, and then Mr. Fenwick Darling, colliery agent, read a paper on the reasons why the electrical system had been adopted. These were (1) the necessity of increasing the plant at the John Henry Pit, where the pumps were needed, was entirely avoided; (2) by keeping the generating plant at the Harry Pit, half a mile away, where a large boiler plant is already in existence, a very large saving in coal is effected, as at nights and week-ends, when coal drawing is not in operation, there is sufficient steam got by the waste heat from the coke ovens to drive the electrical plant; (3) by concentration of plant enabling better and more efficient supervision and reduction of wear and tear, by having all the electrical plant driven by one thoroughly efficient and reliable engine; the generating plant and pump are capable of pumping the whole of the water at present met with in the seams at night, and so long as this is the case, very little steam beyond what is got from the coke ovens will be required, but it is quite possible that a considerable increase of water might be met with at the large fault, known to exist, when it is reached in these seams, and in that case it will only be necessary to put down an additional boiler, and by driving the pumps night and day, there will be no difficulty in dealing with 1,000 gallons of water per minute during the 24 hours, as well as doing the coal-cutting and hauling in the Hutton seam, which it is intended to drive by this plant. Mr. Darling mentioned that the pumping plant had been supplied by Messrs. Scott & Mountain. He did not say that electricity was the power to be used under all circumstances, but the circumstances existing at that colliery were such as made its use eminently suitable.

E.P.S. Batteries.—Contracts for the supply of storage batteries have been placed with the Electrical Power Storage Company, Limited, by the Corporations of Falkirk and Newport, and also by the Windsor Electrical Installation Company, Limited.

Fire Extinction.—*A propos* of our recent remarks on fire extinction, Messrs. J. G. Grimsley & Sons, of Leicester, send us a pamphlet illustrative of their patent automatic fire extinguisher. This device is of the sprinkler type, and its operation is controlled by the expansion of metal with rise of temperature. This has the advantage that as soon as the fire is put out the flow of water ceases. Various patterns of fitting have been devised to suit local conditions, and the apparatus is being shown at the Wolverhampton Exhibition.

For Sale.—Messrs. Percy Huddleston & Co., announce in our business pages to-day an auction sale of water-tube boilers, engines, and three-phase alternators, also D.C. plant, &c., at the Ballsbridge and Clontarf Tramways Depôt, Dublin. The sale takes place on August 21st., not on the date previously announced.

Holidays.—Messrs. Royce, Limited, of Manchester, intimate that their works will close for the annual holidays, to-night, Friday, August 1st, and will re-open on Monday, August 11th. No goods will be received between these dates, but the offices will remain open for correspondence purposes.

Messrs. Foxcroft & Duncan's works will be closed from Saturday, August 2nd to Monday, 9th, inclusive, owing to the two Bank Holidays and the men's beanfeast coming during the week.

New Casing.—A correspondent, Mr. J. D. Palmer, of 305, Strone Road, Manor Park, sends us samples of a new form of casing for electric wires, which he has patented. The device consists of a thin iron, zinc, fibre or other kind of troughing with a slot along each edge, into which the capping, of similar material, is slid in long lengths. The qualities claimed for it are accessibility, simplicity, durability, &c., and the casing, it is said, can be made watertight with paint or varnish. The last claim is hardly tenable; but the casing is certainly ingenious.

Phono-Electric Wires.—We have received a small pamphlet entitled "Phono-Electric Telephone and Telegraph Lines," which, for ingeniously pieced together absurdities, we have seldom seen equalled. The wire which this remarkable effusion describes is stated to have a "perfect power of transmitting electric signals." Without alluding for the moment to what is *not* stated, we may refer to the following:—"Phono-Electric is 1½ times as strong as the best hard-drawn copper." Now the highest breaking strain actually quoted for this wonderful material is 85,500 lbs. per sq. in.; hard-drawn copper, for which no figures are given, we may mention, will bear a strain of 30 tons per sq. in., or 67,200 lbs., *i.e.*, the phono-electric wire has a breaking strain 27 per cent., not 50 per cent., higher than that of the best hard-drawn copper. Next, as to resistance; we observe that phono-electric wire 80·81 mils. in diameter, is stated to have a resistance per 1,000 ft., at 75°, of 3·93 ohms. Now hard-drawn copper of the same gauge has a resistance of 1·65 ohms only, *i.e.*, hard-drawn copper wire is more than twice as good as the phono-electric, from this point of view, though we are informed that "the specific resistance (*i.e.*, the high resistance) of phono-electric wire is a positive benefit." It is stated that under a torsional test the phono-electric wire will stand nearly three times as many complete turns in a given length as will hard-drawn copper; no corroborative figures are given in proof of this; the writer is doubtless unaware that hard-drawn copper wire 80 mils in diameter, will, in a length of 3 in., stand a *minimum* of 25 twists without breaking (Post Office specification); this wire must, therefore, stand 75 twists; we should be glad to receive attested proof of the latter. We are informed "For clear signalling, the absolute conductivity of the line is a matter of far less importance than the proper balancing of inductance and capacity"—truly a clear and concise scientific statement! Also "phono-electric wire gives the clearest speech and the sharpest signals of all materials used for line wire." Will the inventors please state what the actual inductance is in millihenrys, and the electrostatic capacity in microfarads, of the "phono-electric" wire, in comparison with hard-drawn copper wire of similar gauge? Also will they give properly attested evidence of the actual speaking results obtained on, say, two wires 500 miles in length, one of the phono-electric material and the other of hard-drawn copper, both wires being of equal diameter? If such a test were made, and were made public, we are confident that no more would be heard of the valuable electrical properties of the material, whatever may be its mechanical advantages. We do not question the latter, but should be glad to see full tests given side by side with those of hard-drawn copper (to Post Office specification).

Roumania.—The German Chamber of Commerce for Roumania announces that a number of important contracts for the establishment of electrical installations in Roumania have just been concluded. In addition to several private plants of a comprehensive character, agreements have been entered into for the erection and equipment of municipal electric lighting stations at Constantza, Bacau, and Tirgovist, whilst the conclusion of a similar contract for the town of Roman is impending. The largest share of the work has been placed with German firms, but notwithstanding this, says the *Financial Times*, complaints are being made that the German companies pay little attention to the conditions prevailing in Roumania.

Schuckert Losses.—Reuter's Nuremberg correspondent says that the balance-sheet of the Schuckert Company shows a deficiency of 15,500,000 marks, owing to depreciation of material, writing off, and the formation of guarantee funds for depreciation to the amount of 9,000,000 marks. The general meeting to be held on the 19th inst. will have under consideration a proposal to cover the loss by drawing on the reserve fund.

Tramways Exhibition.—The Mica Boiler Covering Company, Limited, had a small exhibit of their coverings for boilers and steam pipes at this exhibition, and a fair amount of business resulted.

The United Engineering Company, of 154, King's Cross Road, W.C., who, it will be remembered, were among the exhibitors at the recent Agricultural Hall show, have sent us some lists of their tramway specialities. They are the sole makers of the "United" rail cleaner, the "Manley" patent fuse and distribution board, other lines being B.E.T. slipper brakes, U.E.C. motor cars, and the British sand box.

Westinghouse Works.—A few days ago the Lord Chief Justice, Lord Alverstone, accompanied by a party including Mr. Justice Wills, Mr. J. K. Bythell (chairman of the Manchester Ship Canal Company), Sheriff Agnew, and other gentlemen, visited the large new works of the British Westinghouse Electric and Manufacturing Company at Trafford Park, Manchester. The visitors journeyed to the works by railway in a special single saloon train, alighting actually at the machine shop, which is the largest engineering shop in the kingdom, and made a complete tour of the various departments. Lord Alverstone expressed a desire to repeat his visit at some time in the near future, when manufacturing operations will be in full swing.

What Our Consuls Say.—*Germany.*—The manufacture of electric machines, Consul-General Oppenheimer (Frankfort-on-Main) reports, is particularly flourishing in Germany. The exports, he states, amounted in 1900 to £1,160,000, the imports to £325,000. The electrical industry of Germany, owing to the constant competition of the larger banking establishments of the country and their readiness to advance money, often without the necessary investigations, for the development of industrial enterprises, was enabled to find, during a number of years, fresh capital for investment in its enterprises, and thus to develop to very considerable proportions. But as soon as money became scarce, the facility of further expansion ceased, and this, remarks Consul-General Oppenheimer, in his report on the trade in the consular district of Frankfort-on-Main for the year 1901, for a number of concerns, meant the beginning of the

inevitable reverse. During the upward movement the electrical industry was the banker's spoiled child, so that one electrical issue followed the other. For this, Mr. Oppenheimer states, there was some justification, inasmuch as the industry needed tremendous capital for the establishment of electrical central power and light stations in the prosperous cities, and for the conversion of the system of horse tramways into one of electric cars. Some cities, like Frankfort, most successfully undertook to manage such business themselves, but the initial outlay in every case required much capital; in other cities the electrical companies undertook the task for their own account, and thus tied up considerable funds for many years to come. The activity of the electrical enterprises, Mr. Oppenheimer states, was first checked by the tightness of the money market, which drove the rate of interest to a very extraordinary figure, but afterwards the universal distrust against new enterprises further handicapped fresh developments. Then, again, came technical improvements in gas lighting, and the average high price of electric light, influenced the investing public, which began to show greater reserve. The participation of some companies in unsound foreign enterprises, which ended in heavy losses, further undermined the public confidence. Yet, says Mr. Oppenheimer, it must be admitted that the prospects have continued throughout, and still continue fair, for developing electrical lines and for supplying entire branches of industry with electric power, although the heavy competition of the companies among themselves frustrates an improvement in prices. In the electrical industry, as in so many other branches, Mr. Oppenheimer thinks an improvement can only be expected with a general turn in the tide of trade.

Corea.—Mr. H. J. Mühlensteth, the able and energetic director of the Imperial Corean Telegraphs, has furnished Mr. H. Goffe, the Acting British Vice-Consul at Chemulpo, with the following particulars of the working of the telegraph system during 1900, and he and his staff are to be sincerely congratulated on the successful results which have attended their efforts. No less than 474 miles of line have been added to the system during the past 12 months, bringing the total mileage in operation up to 2,170 miles, while the number of offices open for the transmission of messages has been increased from 23 to 27. During the same period the receipts amounted to £8,300 with 152,485 telegrams, as compared with £7,244 and 125,410 messages for the preceding year. It is hoped that with careful management the department may soon be able to pay its own way instead of being, as at present, a charge on the Imperial revenue. The following is the list of offices open to the public in Corea, the orthography employed being the officially correct one as used in the "Nomenclature officielle des Bureaux telegraphiques du Monde," a copy of which is supplied to every telegraph office in the world:—Echow, Anchu, Unsan, Chinnampo, Pingyang, Kaisung, Seoul, Chemulpo, Kunsan, Kongchu, Chunchu, Mokpo, Tehkoo, Massampo, Fusan, Yuensan, Hamhiung, Haichu, Kimsung, Chungchu, Kivangchu, Chinchu, Pukchong, Kiongsang, Sungchin, Givendoline, Yeng-bin; offices at Hiveiriong and Kronghung are to be opened later. Telegrams handed in for transmission in any other orthography, if not refused, are at "sender's risk" and will always be subject to more or less delay. The "Westernisation" of Seoull (Corea), is reported to go on apace. An electric tramway now embraces a large portion of the city and suburbs; the principal thoroughfares are lit with electric light, which is installed also in the Palace and many private houses; a handsome new Japanese Post Office has recently been erected in the foreign quarter, and a scheme of waterworks for the entire city is talked of. At Chemulpo various improvements are in progress, and the Japanese Post Office is about to inaugurate a telephone service which is to be connected with a similar service in the capital. Among the improvements at Fusan is the installation of electric light and the construction of waterworks.

Russia.—Unless some energetic person steps in, Acting Vice-Consul Hunt thinks that the much-talked-of projects for electric light and tramway, water supply and drainage for Kertch (Russia) are likely to remain unfulfilled for some time to come. A member of the Municipal Council of Kertch, he states, has expressed an opinion that it would be desirable to construct furnaces for the destruction of refuse, such as are in operation in other countries; and as the town has a small electric plant, consisting of five arc lamps, for the lighting of the sea-walk, a project of utilising the above-mentioned furnaces for producing the electric energy would be welcomed by the municipality. The projected installation of electric light, electric tramway and waterworks at Mariupol (Russia) are reported to have made no headway, and the Municipality of Mariupol is still open to receive tenders for the fulfilment of those plans. Vice-Consul Walton thinks there are still good openings at Mariupol for electrical machinery and appliances, and, in fact, machinery of all kinds.

Spain.—A new line of electric tramways was constructed last year from Barcelona to the outlying district of Horta. The line, according to a recent report, which was opened in July last, is 6 kiloms. (3¾ miles) in length, and is worked by the "Compagnie Anonyme de Tramways de Barcelona à San Andres and extensions," a Belgium company having a capital of £240,000. The central station, which is situated at about three-fifths of the distance between Barcelona and Horta, contains a plant, capacity 800 H.P., supplied by a Paris firm, which supplies gas to two gas engines of 150 H.P. and one of 300 H.P. each built by Crossley Bros. These are directly coupled to three continuous current dynamos, which supply current to the line at a pressure of 500 volts. The company owns 12 electric cars, each fitted with two Thomson-Houston motors of 25 H.P., and 16 trailer cars. They maintain a 10-minutes' service throughout the day, and their gross receipts, Consul-General J. F. Roberts states, average about 1,200 pesetas per day. The whole of the work was carried out under the superintendence of the company's engineers, and the contractors for most of it were a British firm, Messrs. F. H. Bagge & Co, electrical engineers, of Barcelona. Nearly all the old mule and steam tramways, it is stated, are being converted for electric power, and tramway extension is one of the greatest sources of labour at present. New lines are being put down in all directions, and next year, Mr. Roberts anticipates, will see a still further development of the electrical system. The entire importation of cables for electric lighting into Alicante (Spain) during 1900 and 1901, Vice-Consul Cumming reports, amounted to 290 and 500 tons respectively, the whole being obtained from Italy. The telephone system of Denia (Spain), Vice-Consul Morand reports, was developed considerably last year, the system now embracing the town and the principal country residences around it. To these will also follow the introduction of electric lighting through energy brought from the well-known waterfall of Algar, near Callosa de Ensarria, about 17 miles distant from Denia.

Willans Engines.—The British Insulated Wire Company have placed an order for engines for direct coupling to alternators of Messrs. Johnson & Phillips' make with Messrs. Willans and Robinson, Limited, of Rugby. The Perth (W.A.) Gas Company have also placed an order with the same firm for an 850-H.P. compound engine, intended for the electric lighting of Perth. Another order also received at Rugby is for engines for direct coupling to dynamos of the General Electric Company's make for the electric lighting of Uruguay.

ELECTRIC LIGHT AND POWER NOTES.

Barrow.—The T.C. has decided to apply for a loan of £20,000 for electric light extensions.

Bath.—The T.C. has decided to expend £300 on electric baths, and to experiment with electric radiation for heating the baths.

Belfast.—Mr. P. C. Cowan, inspector to the L.G.B., has held an inquiry into an application by the City Corporation for a loan of £20,000 for electric lighting purposes. In December last the L.G.B. sanctioned a temporary allocation of £4,500 for supplying electricity to the new Royal Victoria Hospital, and in February a temporary allocation of £3,500. It was now desired to borrow £20,000 to recover these sums, and the balance was to provide for new electric works.

Mr. V. H. M'Cowen, electrical engineer to the Council, stated that £2,800 for the main along the Sydenham Road was for the purpose of supply to Harland & Wolff's new engine works and to the Baltic Firewood Company. The application from Harland and Wolff was for 120 H.P., and he estimated that they would get a revenue of £940; the Baltic Company would also pay between £300 and £400 a year. The main required for the Alexandra Dock district was also for Harland & Wolff, and the company had given a guarantee for five years that they would pay a minimum of £1,600 a year for current, and there were inquiries from the Harbour Board and others. The total amount spent on electric light was £202,357 up to December 31st last, and £212,250 was the total amount borrowed. The gross revenue, after paying working expenses, was £9,053 19s. 1d. There was a loss of £347 after charging interest and sinking fund out of the net revenue. They proposed to supply Harland & Wolff at the ordinary price per unit; that was 3d. for the first hour. For more than 20 hours a day for five days a week the uniform rate was 2d. Mention had been made at the last Committee meeting of a further application of £30,000 for electric lighting.

Bexhill.—The U.D.C. has decided to apply to the L.G.B. for permission to borrow £16,000 for electric light works.

Bristol.—The electrical engineer, Mr. Faraday Proctor, has submitted to the Electricity Committee estimates amounting to £64,178 1s. for enlarging and equipping the Avonbank Works so as to double the present effective capacity, leaving space for an additional engine and alternator at some future time. A further estimate of £19,733 for erecting and equipping 365 five-ampere arc lamps, with the necessary mains, has also been prepared, together with £1,500 for the purchase of additional transformers for private lighting.

Broadstairs.—The public arc lamps were lit for the first time on July 23rd. The work has been carried out by the Isle of Thanet Tramways and Electric Lighting Company, Limited, who supply the current.

Bulawayo.—A cooling tower has just been erected at the electricity works.

Cape Town.—Messrs. Ferranti, Limited, and the English Electrical Manufacturing Company (through Messrs. Dick, Kerr and Co.) have between them lately completed an important electrical contract for the Cape Town Corporation, the first named supplying an engine of their standard vertical cross-compound type, with a working pressure of 160 lbs. per sq. in., and the latter firm supplying the dynamos. These generators are designed to give 700 KW. output and considerable overloads for long periods. The field yoke of this generator is of a special quality cast-iron with laminated steel pole-pieces, which are cast into the yoke; the armature is of

the drum-wound type, the laminations being built upon a special form of spider. It is claimed for these machines that they will run at 50 per cent. overload without shifting the brushes.

Coventry.—The annual report of the Electric Light Committee shows that during the year they added 44 new customers to the department, and increased the number of lamps by 3,589. The units sold increased by 18 per cent. The sale of energy for motor purposes increased by £553, or over 9 per cent. The cost of production was £250 less. The statement would have been still more favourable if it had not been for the fact that they had consumed a great deal of their coal at the old contract price; they had also to allow rebates for five quarters in one year. The reductions, said Ald. Hill, had been brought about in great measure by the vigilance of the new manager (Mr. Jeckell). The reduction of prices to the consumers had taken £300, which, of course, if it had not taken place, would have been to their credit. Their two large two-phase plants were now ready to be transferred to Coventry, and everything was in order to receive them. They had received sanction for the purchase of motors for the purpose of hiring them out, and they looked forward to the use of these to increase the load, and benefit their finances. The works' cost for the half-year ending March, 1901, was 2·67d. per unit, as against 1·64d. in 1902. The capital charges per unit worked out at 2·46d. this year, as compared with 2·66d. last year, and the average price obtained this year was 3·82d. per unit, as compared with 4·15d. During the whole year no failure of the light occurred.

Dartford.—The South-Eastern Electric Light Company have notified the R.D.C. that they intend to apply for a prov. order to supply electricity in the Council's area. The Kent E.P.D. Co., Limited, have also given notice to a like effect.

Dawlish.—Messrs. Crompton & Co., have offered the U.D.C. to put down an installation for electric light, and to contribute £200 towards the cost of a prov. order.

Derry.—The County Council has passed a resolution, proposed by Mr. S. M. Macrory, of Limavady, to the effect that a special committee be appointed to inquire into the following points:—(1) How far the county of Londonderry is covered by electric supply companies under Acts of Parliament; (2) as to any special facilities existing in the county for generating electricity by waterfalls; (3) as to the financial results of electric schemes undertaken by municipal bodies; (4) how far it would be practicable and wise to develop a scheme for an electric supply for the county; (5) as to the best mode of procedure for giving effect to their recommendations. Mr. Macrory advocated the abandonment of the River Bann Navigation Works, which are a heavy tax on the ratepayers of counties Derry and Antrim, and pointed out that costly weirs and locks could be utilised for the purpose of establishing, at small outlay, the largest hydro-electric generating station in the country. Power would be transmitted to the surrounding towns, including Belfast and Londonderry, which are 40 miles distant on either side, to the extent of 10,000 H.P., or more. The project is one of great importance, and the findings of the committee will be awaited with interest. A further resolution proposed by Mr. Macrory, and adopted unanimously, was to the effect that the Government should be asked to insert clauses in the Local Government (Ireland) Amendment Act, 1902, to enable Irish County Councils to promote Bills in Parliament for objects such as the following:—To construct and work tramways and ferries, to obtain powers for the utilisation of water-power, &c., and to create county stock for these purposes.

Durban.—According to the *Diamond Fields Advertiser*, the T.C. on June 23rd decided to indent for £25,000 worth of electrical machinery, so as to overtake the extraordinary demands made for electricity.

Eccles.—An inspector of the L.G.B. has held an inquiry into an application of the T.C. for sanction to borrow £22,115 for electric lighting purposes. The electrical undertaking lost in 1901 a sum of £867. By the proposed electrical extensions it is hoped to make the undertaking a success.

Elmton-with-Creswell.—The P.C. has decided to adopt electricity for street lighting.

Epsom.—The R.D.C. has received from the Leatherhead and District Electricity Company notice of their intention to apply for a prov. order authorising the supply of electricity throughout the parish of Fetcham. No objection was offered.

Festiniog.—The U.D.C. is negotiating with the Yale Electric Supply Company for lighting the streets by means of arc lamps.

Gillingham.—About £3,000 is to be spent by the U.D.C. in extending the electric light works.

India.—The last issue of an American exchange contained the following note:—"The British Indian house of Tata and Co., is desirous of securing data regarding water power plants, which their principal partner, Mr. J. N. Tata, of Bombay, one of the most influential and richest men in India, proposes to build, for the purpose of operating extensive iron and coal properties located in the Chanda district, Central Provinces. All the equipment will be of American manufacture and the expenditure will reach into the millions. Mr. Tata, who is now in London, will, according to present arrangement, arrive in the United States some time in September."

Italy.—The Communal Council of Venice has approved of a convention with an Italian company for the transport to Venice of the electric energy necessary for the lighting of the town of Venice by electricity, and supplying motive power for public and private uses. The energy would be derived from the Cellina torrent. In virtue of this convention, Venice would have electric energy and electric lighting at a very low price.

Launceston.—The Town Council is negotiating for an installation of electric light in the town, where gas and acetylene light are at present in competition.

Liverpool.—Last week Major C. E. Norton held an inquiry on behalf of the L.G.B. into an application by the City Council for sanction to borrow £300,000 for purposes connected with the supply of electrical energy. It was stated that the output in 1900 had increased to 11¼ million units; and in 1901 to 20 millions. This year the estimate was put at 22½ million units; the Corporation had borrowed a total of £1,200,000, the whole of which had been expended in keeping pace with the requirements of the city. The charges for electric lighting had been considerably reduced, and were now 3¾d. per unit up to 3,000 units per quarter, and for supplies beyond that 3d. per unit. The present charge for power was 2d. up to 3,000 units, and beyond that 1½d. per unit. The number of lamps supplied was 100,041. Mr. A. B. Holmes, electrical engineer, put in statements as to the proposed new stations, and the inquiry was closed.

Loughborough.—The T.C. has decided to open negotiations with the Loughborough and District Light Railway Syndicate with reference to the exercise or transfer of the electricity powers of the Corporation.

Maidstone.—The South-Eastern Electric Lighting Company have given the R.D.C. notice of their intention to apply for a prov. order to supply electricity within the Council's area.

Newton Abbot.—An offer from the Electric Supply Company to light the town with considerably more power than at present for the same price as now paid for gas, or to give practically the same light as provided by the gas lamps at a reduced cost has been referred by the Urban Council to a committee.

Pontypridd.—The Barry Railway Company have notified a probable intention to oppose the District Council's application to borrow £45,000 for the erection of an electrical supply station. Mr. Hill, the manager of the South Wales Power Company, has also written the Council stating that the company cannot reduce their service below that offered on July 3rd.

Spain.—Application has been made for a concession to put down a plant to utilise the water power of the River Ason at Valle de Soba (province of Santander), in the generation of electrical energy for lighting and power purposes.

Stoke-on-Trent.—The T.C. has adopted the scheme prepared by the electrical engineer (Mr. P. J. S. Tiddeman) for an electricity supply within the borough, at an estimated cost of £30,640. It was decided to apply for sanction to borrow this sum.

Sydney.—Messrs. Preece & Cardew recently informed the City Council that 55 complete tenders had been received from 21 firms in connection with the electric light generating plant, the prices ranging from £46,089 to £79,282, and completion from one to two years. The lowest tenders were, it was stated, very close, and would require very careful analysis. The four lowest were all from English firms, and the plant was practically all English-made. Since the foregoing was written the result has been announced, and is stated in our "Contracts Closed" to-day.

Worthing.—An inquiry into the Corporation's application for a loan of £8,459 for additional plant for the electricity undertaking was held on Friday last. The consulting engineer (Mr. Monkhouse) stated that there was a great increase in the demand for electricity, and the estimate that there would be at the end of the first year, in September, an equivalent of 6,000 8-C.P. lamps in consumers' premises, had already been exceeded by 2,500 lamps, and further applications brought the total to 9,500, whereas with the present plant they could only supply 6,000 lamps. It was proposed to acquire a new steam dynamo and boiler of a capacity of 250 KW. to carry them through the winter, and next year they would have to apply for a further loan. There was no opposition.

York.—The results of the second year's working of the electric light undertaking show a total revenue of £6,110 4s. 8d., as against a total revenue last year of £3,802 15s. 5d. The total cost of generation and management has been £3,518 8s. 10d., as against £2,276 9s. 7d., and the gross profit is £2,591 15s. 10d., as against £1,526 5s. 10d. last year. Interest and sinking fund absorb £2,242 0s. 3d., leaving a net profit for the year ending March 31st, 1902, of £349 15s. 8d., as against a net profit of £98 15s. 9d. last year.

ELECTRIC TRACTION NOTES.

Blackpool.—The B. of T. not being satisfied with the new guards adopted for the electric trams, has requested the Corporation to furnish a statement of particulars of all recent tram accidents.

Bournemouth.—The first section of the Corporation tramways, between Lansdowne and Pokesdown—the section which has recently been the subject of litigation—was finished and tested recently, and on Wednesday last week it was inspected on behalf of the Board of Trade by Major Pringle and Mr. Trotter. The inspection was satisfactory, and the cars commenced running for traffic later in the day.

Brussels—Antwerp Electric Railway.—The concession of this line has not yet been definitely accorded, but it is rumoured that an application that has been received from Messrs. Empain Frères, the promoters of the Paris Metropolitan, is being favourably considered, and that it will, in all probability, be acceded to. According to Messrs. Empain's project, the journey between Antwerp and Brussels—a distance of 42 kilometres (25·2 miles)—would be effected in 25 minutes at a fare of 1 franc or 1 franc 25 c. The cost of construction of the proposed line is estimated at about 45 million francs.

Cardiff.—There has been a phenomenal increase in tramway traffic, and the total receipts for the three months ended June 30th was £15,960. For June alone the average per car-mile works out at 14·47d. for the electric cars and 6·47d. for the horse cars. Mr. Ellis, the engineer, has had a Lisbon offer of £1,500 a year, but he is under an agreement with the Cardiff Corporation.

Chester.—The T.C. on Monday adopted recommendations of the Lighting and Tramways Joint Committee, with respect to tenders for the work of the new electric tramways, that the tender of Crompton & Co., Ltd., for a reversible booster for £357; the tender of the Tudor Accumulator Co, Ltd., for a battery for £1,268, and to maintain the same for 10 years at £77 per annum, and that of Callender's Cable Co., Ltd., for cables, at the sum of £2,799 2s., be accepted. The tender of Messrs. R. W. Blackwell & Co, Ltd., London (£40,182 19s.), was also recommended for acceptance.

Durban.—The electric tramway service was recently extended. The local Town Council lately accepted an American tender for the supply of additional tramcars. Councillor Middleton, at a recent meeting, raised the patriotic question, and strongly urged the point that such orders should be placed in England. The Council authorised the ordering of additional electrical plant for the new power station, entailing an expenditure of £25,000.

East Ham.—The electric tramways at East Ham have completed their first year's working, and the following details of the results, drawn up by Mr. W. C. Ullman, the engineer and manager, will be of interest:—

Traffic receipts	£30,141 9 11½
" " per car-mile	9·61d.
" " per passenger	·665d.
Car-miles run	502,942
Passengers carried	7,261,667
" " per car-mile	14·43
Units used	479,457
" " per car-mile	·95
Average passengers carried per day	19,895
" receipts per day	£55 8 7
" miles run per day	1,377
" units used per day	1,313
" number of cars running per day	14 to 22
Cost of power per car-mile	2·32d.
Miles of route open	5·3d.
Passengers carried per mile of route	1,370,126
Percentage of ½d. passengers carried	74·9 per cent.
" of 1d. " "	18·9 per cent.
" of 1½d. " "	4·5 per cent.
" of 2d. " "	1·7 per cent.

The returns for week ending July 26th, with about 20 cars running, are as follows:—Miles run, 11,995; passengers carried, 1,747,763; receipts, £451 4s. 10d. For the corresponding week for July, 1901, with 14 cars, the figures were:—Miles run, 7,466; passengers carried, 120,211; receipts, £359 10s. 9d.

France.—The project to convert the accumulator system of electric tramways in the town of Dunkirk into trolley lines, has been officially approved.

Halifax.—The Corporation Tramways Committee on July 23rd, decided by a majority of two votes not to extend the electric tramways to Brighouse, Hipperholme and Greetland, the inhabitants of which towns recently petitioned the T.C. for a service of trams.

Lancashire and Yorkshire Railway.—It seems that the rumours regarding the electrification of this railway have been an exaggeration of the real position. According to the *Daily Mail* it appears that when electricity is tried it will be will be on a branch line running from Manchester or Liverpool through residential districts. The population is very dense there. Between Liverpool and Southport there is already a 15-minute service, and around Manchester some branches have trains nearly as often. With electricity the interval would have to be five minutes, or less. With cars equipped on the multiple unit system, the trains could be made long or short, as the traffic required at different hours of the day. No particular section of line has been chosen for trial, but the practical details of the traffic and management are being worked out with a view to a trial of electrification on the lines indicated.

L.C.C.—At Tuesday's meeting the adjourned report of the Highways Committee recommended and the Council decided to approve the revised estimates (particulars of which were given last week) amounting to £981,497 for the conversion to electric traction of the Westminster—Tooting and two other lines. It was decided to authorise the Works Committee to erect the chimneys for the power station at Greenwich at a cost of £18,750, and to construct the foundations, and to build the proposed sub-stations at Clapham, Brixton, and the Elephant and Castle at an estimated expenditure of £22,500.

Newport (Mon.).—The Electricity Committee has decided to recommend the Corporation to proceed with the electric tramway from the Westgate in the centre of the town to the cemetery, a distance rather more than a mile.

N.E. Railway.—The electrification of sections of the North-Eastern Railway for which tenders are now being invited forms the subject of comment in the *Times* as follows:—"The directors have decided to convert a considerable portion of their branch local lines from steam to electricity as an experiment, but an experiment that will become the adopted practice if it should be found to be successful. The company has had the monopoly of the goods and passenger traffic in Northumberland and Durham and a large part of Yorkshire these many years—ever since it was a company, indeed; but now it is faced by the active competition of the electrical tramways systems that are springing up all round. The local tramways have hit the company badly. The Newcastle Corporation tramways carry an average of 800,000 people a week; north to Gosforth, east to Heaton, west to Elswick and Scotswood; while the Gateshead Company's trams convey many thousands daily to the suburbs of Low Fell and Bensham and others. Multitudes of these people used to be taken by the railway company to their homes, and now, in consequence of their preference for the quicker and more frequent service of the trams, the company's receipts have admittedly suffered considerably. In order to meet this competition, the company proposes to electrically equip some of its branch lines. There is a loop line from Newcastle through the towns on the river side to North Shields and Tynemouth, and back again, by way of Backworth, to Newcastle, with its terminus at New Bridge Street. There is a space of half a mile between the two stations, but this is being connected, and there will soon be a complete circular route which will be greatly to the advantage of seaside and suburban residents. It will also help the railway company to compete with the tramline that is being laid down by the Tyneside Tramway Company from Newcastle to the coast. The company is constructing, also, a narrower circle taking in the suburbs of Benton and Forest Hall. These are the principal lines it is proposed to equip with the new engines. The company is constructing, in addition, a light line to Ponteland, seven miles to the north-west of Newcastle, and that will be equipped in the same way, as will also the short line of railway that brings from the quay the merchandise that is landed there from ships to the Trafalgar goods station, whence it is despatched all over the country. The engines are in course of construction in the Park Lane shops, Gateshead. They will be driven by electrical accumulators, and will shortly be ready for putting on the line." Doubtless the last sentence applies only to the short line from the wharf to the goods station.

Oldham.—Prof. Kennedy's assistant has informed the Committee that he is of opinion that they will be able to produce energy by the end of August from the new station at Greenhill, a portion of which has been pushed on rapidly. It has been decided to order 13 more cars from Messrs. Dick, Kerr & Co., in addition to those now being constructed. Mr. Hewitt (Messrs. Hewitt and Rhodes, consulting electrical engineers) considers Oldham should eventually need 120 cars. The capital expenditure on the tramways scheme up to date is £167,910. Mr. Hewitt has asked the Committee to experiment with a patent guard for the trolley wires, which would cost about £134 per mile. The Committee decided to try the experiment.

Potteries.—The B. of T. has consented to the Potteries Electric Traction Company, Limited, running baggage wagons over the entire tramways system, and the delivery and collection of parcels has been commenced.

Preston.—A recommendation came before the Council the other day that the Tramways Sub-committee be authorised to advertise for a resident engineer to superintend the construction and working of the new electric tramways.

Prestwich.—The U.C. has approved of the draft agreement with Salford T.C. for the provision of an electric tram service for the district, and it is to be submitted to the B. of T. for ratification.

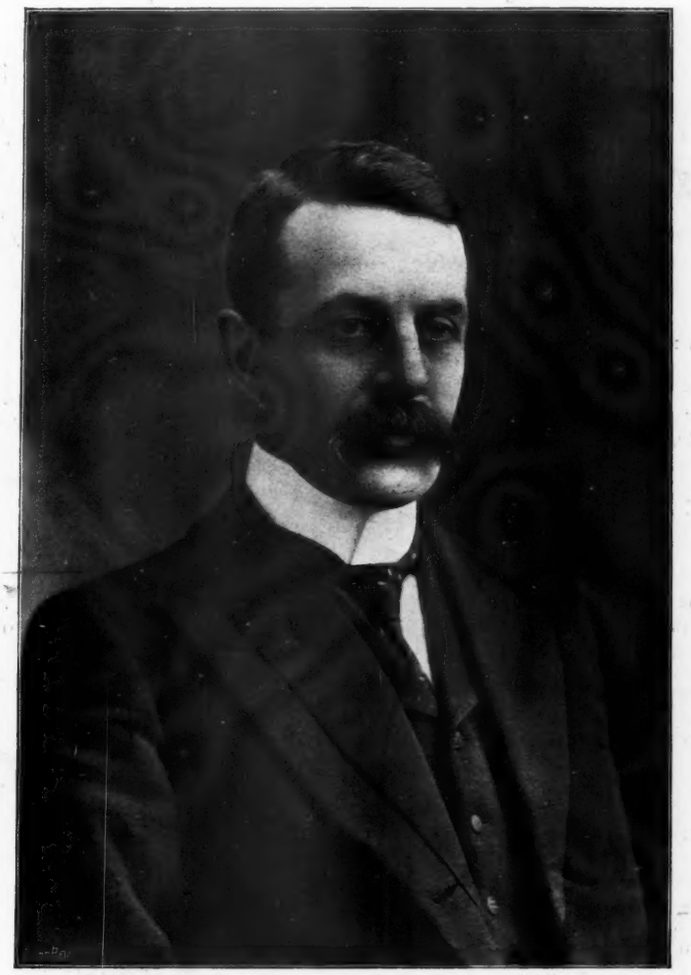
Rowley.—At a meeting of the D.C. last week a letter was read from Mr. J. A. Lycett, district superintendent of the B.E.T. Co. intimating that an application was now pending to the B. of T. for permission to operate light railways with upper-decked cars, so that the tramways and light railways may each be served with the same type of car. It was, however, considered by the Council that the use of the upper-decked cars in the Rowley district would be dangerous. The chairman said that if they allowed such cars to be used in the district they would be endangering the lives of the people. It was decided by the Council to oppose the application.

Sheffield.—A 31-ton armature, made by the British Thomson-Houston Company at their Hamburg works, for the tramway power station at Kelham Island, was landed from the canal without mishap on July 24th.

(*Continued on page* 191.)

JAMES SWINBURNE.

At the recent conversazione of the I.E.E., many remarks were overheard on the youthfulness of the President. Forty-four is not a great age, but Mr. Swinburne is younger even than his years. However, "youth's a stuff will not endure," and some day even our President may become a grave and reverend past-president. It is significant of English respect for what is old and established that our young profession, made up, in the bulk, of young men, should have been able to fill its chief post of honour with seniors. We know, from the experience of the very active and enterprising sister Institution in the United States, whose presidents have all, or nearly all, been young men in the active pursuit of their profession, that there is nothing to be said against such men for such positions. This may be said without any reflection on any of the able presidents who have served the Institution so well in the past.



James Swinburne, President Inst. E.E.

Mr. Swinburne has very excellent qualifications for the head of a profession which represents the combination of electricity and engineering. He was trained under the practical surroundings of a locomotive and marine engine works on the Tyne; then followed experience as a gas works engineer at South Shields; 1881 — 2, the years which saw the practical advent of domestic electric lighting in the commercial introduction of the Swan lamp, found Mr. Swinburne employed in establishing factories for the manufacture of those lamps on the Continent and in America.

In 1883 he was experimenting on forms of accumulators; in 1884 he started the manufacture of a lamp of his own. Then, from 1885 to 1889, he was engaged in Crompton's works, working with Mr. Crompton on the development of the modern dynamo. From 1889, for some years, he was making transformers and electrical measuring instruments, and finding time to act as electrical editor of a technical journal, to lecture at technical institutions, to write and read papers, and to put forth much original and critical matter. In all these things his active mind led him to original theories and to original applications. His own views have generally turned out to be correct—not perhaps altogether and always directly applicable to practice, but always containing a large proportion of truth, and always showing a knowledge in advance of the time.

Thus, whether or not his ideas were suitable for acceptance in their entirety, their promulgation and discussion—and his discussion of other people's ideas—always proved fruitful of knowledge, and contributed much to the rapid progress from the dimness of the eighties to the clear light of to-day.

With his wide experience and his special gifts, it is not surprising that, while acting as a consulting engineer and scientific adviser—and so keeping in touch with practical matters—he should have been constantly called upon to act as an expert and technical witness in the Law Courts, before Parliamentary Committees and in arbitrations and other inquiries.

One of our President's most attractive qualities is his keen sense of humour. He sees the ludicrous side even of such things as attempts to explain the universe—matters which strike most people as pathetic rather than humorous. Once, by way of a contribution to what he called the Christmas number of a technical journal, he sent in about a dozen examples of "Rejected Abstracts." We regret that space does not allow of the reproduction of some of these; they are very witty, not the least humorous being one aimed at himself.

On another occasion—some time early in the eighties, it must have been—at a dinner of "The Dynamicables," he solemnly read a "Paper" descriptive of his difficulties with a London cabman, who only consented to take him to the station at a speed expressed in ohms—resistance being a velocity—on the condition that the fare should be expressed in units of self-induction. The cabman got the best of the bargain by taking advantage of the future president's confusion between the electromagnetic and the electrostatic system, and charging v^2 times—or nine hundred million

billion times—the proper fare. The hearty and continuous laughter of the late Dr. John Hopkinson, the chairman on that occasion, is a thing to be remembered.

It would not be difficult to give examples of our President's quickness of perception, but one illustration must suffice. Prof. Ewing was reading a paper on his theory of magnetism, when Mr. Swinburne pointed out that if there was truth in the theory it led to the conclusion that at very high inductions hysteresis would tend to disappear. Some time afterwards Mr. F. G. Baily proved that this was the case by his well-known experiment of rotating a cylinder of iron in a very intense field.

Newcastle Tramways: Switchboard at Byker Car Shed.

His contributions of papers to the Institution, of which he is now the head, although not numerous, have all been important. One of the most useful was that on the "Theory of Armature Reactions in Dynamos and Motors," read in 1890. His recent paper on "Electric Railways" will be fresh in the minds of our readers. His contributions to the discussions have been very numerous, and it may fairly be claimed for him that, at the meetings of the Institution, no speaker has been listened to with more attention.

His recent incursion into the field of thermo-dynamics at the Physical Society will also be remembered, if only for the reason that it seems to have proved too much for the assimilative powers of that Society, and is awaiting the attention of some critic capable of proving or disproving the theory that it was really a carefully elaborated joke.

If a collection is ever made of Mr. Swinburne's writings, an important and useful part of it will be selected from a great mass of critical matter that appeared in *Industries*, a defunct technical journal, of which he acted as electrical editor.

It is not generally known that he finds relief from a humorous world in the cultivation of a decided musical gift. He probably numbers organ-building as one of the arts on which he can speak as an expert—at one time, indeed, he studied music as a profession. We recently heard a song which struck us as beautiful and musicianly, and having noticed that it bore the initials "J. S.," we taxed the President with it. He excused himself by saying that "somebody must compose these things."

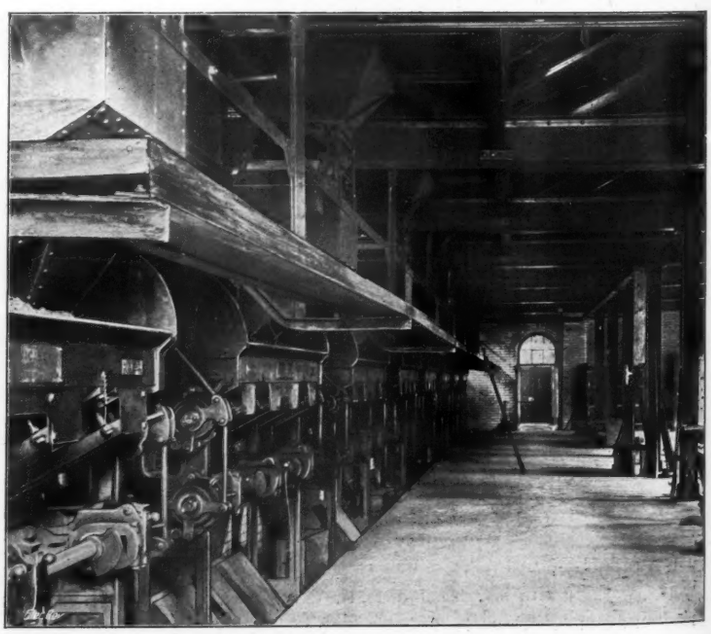
It may be said of Mr. Swinburne that he has made probably no enemies. This is very remarkable, as he has constantly been opposed to people in many ways—in legal and commercial and scientific matters—and has always been an opponent to be seriously reckoned with; the explanation is simply that his unfailing good humour and kindliness have made it impossible for anyone to cherish a grievance against him.

As he is in his professional work, so he is in private life. One who knows him well assures us that he has never seen in him the least indication of irritability or ill-temper. This is no doubt one of the reasons of his remarkable success as a scientific witness. He would probably say that such work was quite easy—that it was only necessary to know more than a judge—but the difficulty of this work may be gauged by the small number of those who succeed in it. While our President is qualified by practical experience to speak as an expert in a number of branches of applied science—electrical, chemical, mechanical—his versatility and knowledge of patents and other legal matters enable him to extend his practice over the whole field of industry. But versatility and knowledge, however encyclopædic, form only a groundwork. Other important and essential qualities are tact, unfailing good temper, quickness of apprehension, a power of concise, simple and logical explanation, an honest desire to see the best side of his own case, and last, but not least, "a good bedside manner." To these add industry and a sufficiency of social qualities, and you have—James Swinburne.

THE ELECTRIC TRAMWAY SYSTEM OF NEWCASTLE-ON-TYNE.

(*Concluded from page* 108.)

The boiler house proper is a one storey building, containing eight Lancashire boilers 8 ft. 6 in. in diameter by 30 ft. long, constructed by Messrs. T. Beeley & Sons, of Hyde, near Manchester, and built for a working pressure of 165 lbs. per sq. in.



Newcastle Tramways: Boiler-house, Showing Mechanical Stokers.

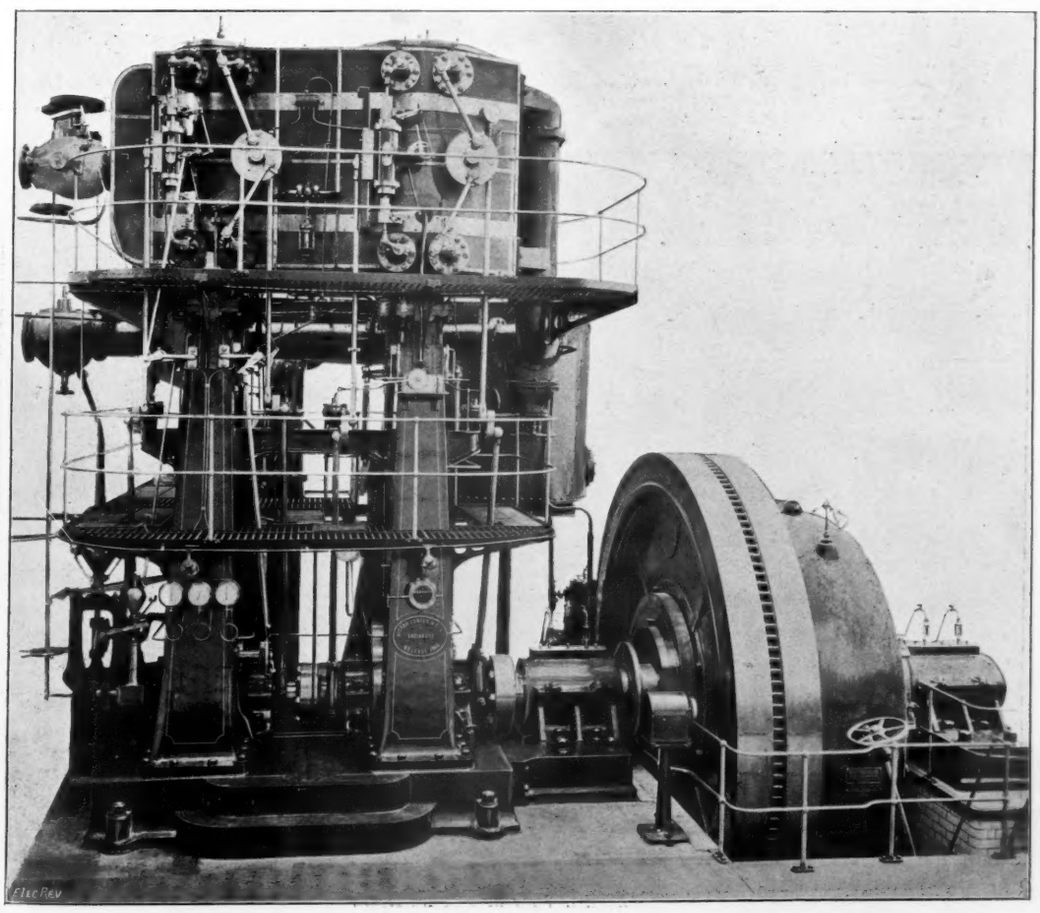
The boilers are provided with Vicars' automatic coking stokers, and into the hoppers of these stokers the coal is led by gravity from the bunkers above, through automatic weighing machines, supplied by Messrs. W. & T. Avery, Limited, of Birmingham. These machines automatically weigh the coal into the hoppers of the stokers, and cut off the supply when the stoker ceases to require coal. The foot-plate in front of the boilers can be tilted up, and forms a shoot through which the ashes, when raked out from the fires, fall through into small trucks in the space below the firing floor. These trucks, when full, are run along to an electrical lift, which hoists them up and tilts them into a bunker, from which the ashes are discharged into carts.

Single-Deck Four-Wheel Car.

It will be seen that this forms a unique arrangement for obtaining the greatest economy in the matter of handling of coal, the whole of the movements from the railway wagons to the resulting ashes being performed entirely by gravity, so that the whole of the boilers can be worked with a maximum staff of two men.

Between the boiler and the engine house is a passage way, which will form the economiser house for future extensions of the plant. Meanwhile, a Green's economiser for the present set of boilers is installed near the base of the chimney. It consists of tubes and scrapers worked by a small steam engine, the exhaust from which, and from the steam feed pump and stoker engine, passes through a feed water heater, which warms the water before it passes through the economiser to the boilers.

The chimney is an octagonal one, of brick, 176 ft. high from the concrete foundations to the stone coping, and of 9 ft. internal diameter right through. It is lined with firebrick for half its height.



Front View of Victor Coates 1,000 H.P. Engine, Coupled to Westinghouse Dynamo.

The engine house is a large steel-framed brick building 53 ft. 6 in. high from the basement to the eaves, 58 ft.

broad, and 202 ft. long, one end being closed by a temporary galvanised partition, which can be taken out to admit of extensions.

At present only half the space in the engine room is utilised, and contains three marine-type engines, two of 1,000 H.P. each, supplied by Messrs. Victor Coates and Co., of Belfast. These engines are compound, and can take an overload of about 50 per cent.; they run at 90 revolutions, with a steam pressure of 160 lbs. per sq. in. The cylinders are 22 in. and 46 in. respectively in diameter, and the stroke is 42 in. Both cylinders are provided with separate Corliss valves for inlet and exhaust, the H.P. valves being worked by trip-gear controlled by the governor, whilst those on the L.P. are worked by trip-gear controlled by hand. Both cylinders are provided with steam jackets and are thoroughly lagged. The fly-wheels are 14 ft. in diameter, and weigh about 40 tons each. All the oiling is automatic.

Double-Deck Car.

The large engine was built by the Wallsend Slipway and Engineering Company, and is of the triple-expansion type, indicating 2,000 H.P. at normal full load. The cylinder diameters are H.P. 24 in., I.P. 39 in., L.P. 61 in., stroke 42 in. Separate Corliss valves are supplied at each end of each cylinder for the inlet and exhaust, those on the I.P. and L.P. cylinders being worked by rocker motion, whilst the H.P. inlet valves are controlled by trip gear regulated by a Whitehead patent governor. The fly-wheel is 18 ft. in diameter, and weighs about 35 tons.

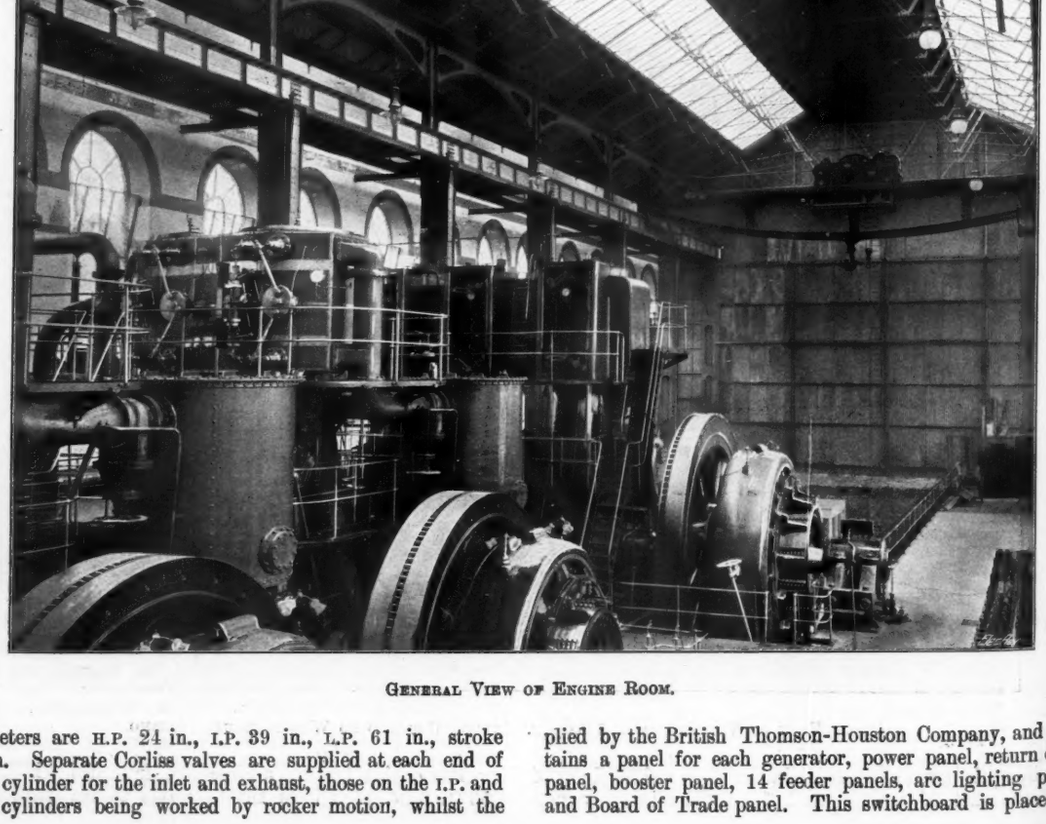
All the engines have surface condensers attached, and Edwards's air pumps, worked off one of the main cross-heads.

Each engine is coupled direct to a multipolar Westinghouse compound-wound continuous-current generator, giving current at 500 to 600 volts.

The engine house has a basement 12 ft. high, which carries the foundations of the engines, and provides room for workshops, stores, and for cables. The whole of the house is lined with white glazed tiles, and has a very clean and pleasing appearance.

An electrical crane, capable of lifting 50 tons, with a span of 50 ft., travels up and down the building; it was supplied by Messrs. Higginbottom & Mannock, of Manchester. A motor is provided for each of the three motions, and a fast travelling hook is also provided to lift a maximum of 10 tons.

On the same level as the floor of the engine house stands a large black enamelled slate switchboard, which was supplied by the British Thomson-Houston Company, and contains a panel for each generator, power panel, return cable panel, booster panel, 14 feeder panels, arc lighting panel, and Board of Trade panel. This switchboard is placed on



General View of Engine Room.

a glass floor, so as to minimise the risk of giving shocks to the attendants.

In addition, there is a double generator motor-driven booster. This can be used for boosting current in and out the station, and for charging the large battery at the top of the office block. This booster has a separate switchboard, with three panels for its control, and there are in addition three other panels for the station lighting and power circuits.

Circulating water is pumped up from the River Tyne, but as the river is about 90 ft. below the level of the engine house floor, and about a quarter of a mile distant, a novel method of providing circulating water was adopted to avoid the heavy losses due to the water having to be pumped to such a height.

Close to the Quayside the pumping station is installed at the Milk Market. It is built of concrete, almost entirely below the level of the ground, and from it three pipes are run across the Quay and down through the Quay wall, two of these pipes being for suction, and one for delivery. The work of installing these pipes was of rather an interesting character, owing to the fact that the Quay wall is built of concrete monoliths. Shafts were sunk behind the wall to the top of the monoliths, and a tunnel excavated at an angle through the concrete Quay between the monoliths to below the low tide level, the water being kept out by means of piles and a cofferdam pad over the end of the tunnel.

In the pumping station itself, two motor-driven centrifugal Mather-Reynolds pumps are installed, which can deliver about 60,000 gallons per hour each, through a 24-in. pipe up to the power station. After passing through the condensers in the power station, it returns through another 24-in. pipe, and drives turbines situated on the same shaft as the motor and pump, so that only about 50 per cent. of the power is required that would otherwise be necessary to pump the water the whole height.

The office block, which adjoins the engine house, is a handsome five-storey building, in the top floor of which is installed a large battery, furnished by the Electrical Power Storage Company, which can provide a maximum discharge of 1,000 amperes for one hour at 500 volts.

The rolling stock is of various types, and was built by Hurst, Nelson & Co., and by the Brush Electrical Engineering Company. 20 are single-deck four-wheeled cars, 28 ft. 6 in. long; 60 are single-deck bogies, 38 ft. 6 in. long, with eight wheels and two motors; 22 are single-deck bogie cars, 38 ft. 6 in. long, with eight wheels and four motors; and 65 are double-deck single-truck cars. All are mounted on Brill trucks. The cars for the heavy gradients are fitted with track brakes, of either the mechanical type or Newell electro-magnetic type, in addition to rheostatic brakes and handbrakes, and all are fitted with Tidswell life-guards.

As regards car sheds, there are at present three, two of which were owned and used by the old tramway company as stables. The roofs of these have been raised to the plans, and under the supervision of the general manager, and converted into car sheds. One is situated at the extreme north end at Gosforth, and a second in the centre of the town, whilst, at the east end, two new car sheds have been provided. One of these, as mentioned before, was intended to be built of brick, but, owing to the bricklayers' strike, a steel-framed concrete building was adopted, and as this could not be got ready in time, owing to the strike, an additional galvanised shed was put up, in which the whole of the work of car construction was done.

The galvanised shed is 200 ft. long by about 132 ft. wide, and contains 10 tracks. Now that its primary use for the temporary accommodation of cars is over, it is being converted into a wood-working shop, in which the car bodies will be built.

The concrete shed is a very large one, the main bay to the east being 600 ft. long × 33 ft. span, whilst the other part is 400 ft. long, and has three spans of 33 ft. each and one span of 27 ft. The east bay is being fitted up as a machine tool shop to contain a good assortment of machine tools, and as large stores and paint shop. This bay has one track down its entire length, and is spanned by a 6-ton electrical crane. The three middle bays contain three tracks each, and will be used as running sheds, whilst the west bay contains two tracks, and has a second storey forming mess room and battery room.

The chief tramway officials are :—Mr. A .E. Le Rossignol, M.I.E.E., engineer and general manager, to whom we are indebted for assistance in the preparation of this article; Mr. C. J. Couper, traffic superintendent; Mr. H. Richardson, power station superintendent; Mr. E. H. Fleming, rolling stock superintendent; and Mr. T. P. Easton, chief clerk.

ELECTRIC TRACTION NOTES.

(*Continued from page* 186.)

Spain.—It is proposed to construct an electric tramway between Vitigudino, Lumbralles and Fermoselle. Certain available water-power will be utilised in the generation of the necessary electrical energy.

Sussex.—The West Sussex County Council has approved of the scheme of the British Electric Traction Company to provide a service of trams between Hove and Worthing.

Warrington.—The Board of Trade has extended the time for the completion of the electrical tramways from August 6th, 1902, to August 6th, 1903.

Wolverhampton.—Last week Ald. C. T. Mander, chairman of the Tramways Committee, invited a large company to meet him at the commodious tram depôt on the Cleveland Road, where the Lorain system of electric traction was inspected, after which the party were taken to the Art and Industrial Exhibition, where they were the guests of the worthy alderman at luncheon. Subsequently "Success to the Wolverhampton Tramway System" was proposed by Mr. T. B. Cope, J.P., and Alderman Craddock, in reply, mentioned that during June the trams carried no fewer than 366,764 passengers, ran 23,000 miles, and earned £1,737, which worked out at 1s. 6d. per mile. He added that, in the matter of passengers, they had been greatly assisted by the Exhibition now being held, and he believed they had in the trams a splendid investment, and one which would be a source of profit to the town. Ald. C. T. Mander, on the other hand, when replying to a vote of thanks, said, so long as the trams paid expenses, and were not a burden upon the rates, he should be perfectly satisfied. It was a well-known axiom that if a tramway was earning 1s. per mile, a faster service should be run, and if Wolverhampton was earning 1s. 6d. per car-mile, they should certainly be increasing the service for the benefit of the public.

TELEGRAPH AND TELEPHONE NOTES.

American Pacific Cables.—The New York correspondent of the *Evening Standard* quotes the *Tribune* as saying that Mr. Mackay's death will not prove to be obstructive of the Pacific cable project. It attributes the defeat of the rival plan to Mr. Ward having filed at Washington last winter thirteen stipulations, which are given verbatim, for the protection of American interests. This sufficed to kill the plans for a Government cable or for a private American cable, subsidised to enable the purchase of the cable from American manufacturers. Requests for soundings by the navy were pending when Mr. Mackay died. Admiral Bradford's report is favourable, but conditioned upon further guarantees. One requires a route to Manila *vid* Guam, without landing on the soil of any other nation. Another requires the employment exclusively of American operators. The president favoured the project, but took the matter away from all other departments, and concentrated all details in the Attorney-General's hands. The *Tribune* asserts further that mutual co-operation between the Government and the Cable Company is certain. The company will get more than it expected, including a stipulation for the protection of all its landing places. The route surveyed by the *Nero* is perfectly feasible. From Honolulu westward 853 soundings were made. 500 miles east of Guam the world's deepest soundings made 4,900 fathoms. Just west of Midway an island mountain rose within 82 fathoms. The surface routes from Guam to Japan and the Carolines are abandoned. Completion to the Philippines within a year is possible. Government business will have the priority at half the regular rates, $1 being the maximum at Manila or China, and 50 cents between San Francisco and Honolulu, becoming 35 cents within two years.

The *Electrical World* says that the Commercial Pacific Cable Company has laid before the administration at Washington a proposal that if the soundings in the Pacific Ocean, taken by the United States boat *Nero*, are thrown open to that company for use in laying its cable, the company will agree to have the entire cable from San Francisco to Manila laid and in operation by June 1st, 1903. This is over 1½ years sooner than the company has at any time before indicated that it could put the cable into operation. It appears that the United States Government has already published the general soundings between San Francisco and Manila, but has in its archives details which are essential to the laying of the cable, and these are the details which the Commercial Cable Company wishes to use.

Hull Telephones.—It was reported at the T.C. meeting on Monday, that the Postmaster-General had granted the Corporation a telephone license.

London (P.O.) Telephones.—It is stated in the daily papers that 24th ult. ended the first half-year's working of the Post Office telephone service in London. At the inauguration in February there were 200 subscribers on the books; now there are 2,000 connected with the Central Exchange alone. It is hoped that the exchanges in Cromwell Road, South Kensington, Victoria Street, and at Wimbledon will be opened early in August.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
Communication with Bolama	April 18, 1902 ..	..
St. Lucia-St. Vincent	May 8, 1902 ..	..
St. Lucia-Grenada	May 8, 1902 ..	..
Dominica-Martinique	May 8, 1902 ..	..
St. Lucia-Martinique	May 8, 1902 ..	..
Guadeloupe-Martinique	May 9, 1902 ..	..
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902 ..	..
Puerto Plata-Martinique	July 10, 1902 ..	..
Cap. St. Jaques-Haiphong	July 12, 1902 ..	July 28.
Landlines :—		
Route *via* Hanekin on Persian territory	Feb. 24, 1900 ..	..
Communication with Tientsin and Taku *via* Helampo	July 18, 1900 ..	..

Tunbridge Wells Telephones.—We reproduce the following letter from the *Financial Times* :—

"A paragraph has gone the round of the Press to the effect that a profit of £130 had been made on the first year's work of the Tunbridge Wells municipal telephone system. As this ratepayers' league is the outcome of a vigorous opposition on the part of a large number of the ratepayers of this borough to the further speculative trading on the part of the Town Council, will you permit us to call attention to the inaccuracy of the paragraph in question, which is calculated to seriously mislead other municipalities and the public generally? The facts very briefly stated are :—(1) That the accounts are for a period of eight, not twelve months; (2) that not one penny is written off for depreciation or renewal of plant, although in the engineer's estimate a renewal fund of 3½ per cent. per annum on the capital outlay was provided for; (3) that the sum of £35 1s. 4d. only is charged against the concern in respect of interest on the capital sum of £19,773 spent on construction prior to March 31st, 1902, the date of the account; (4) that nothing is charged against the undertaking for the sinking fund provided for in the estimates, which on a loan of £19,773, repayable in 25 years, would amount to a considerable sum for the period of eight months; (5) that an undue proportion of expenditure in respect of wages, salaries, and disbursements has been debited to capital. Without entering into other debateable questions, of which there are many, it is apparent that the alleged 'profit of £130 on the first year's working' is commercially fictitious. These are facts which we think cannot be too widely known, and in the public interest may we ask you to give them publicity in your columns?

"Trevenen J. Holland, Chairman.
"H. T. W. Barron, Hon. Secretary.
"E. Elvy Robb, Hon. Solicitor.
"Tunbridge Wells Ratepayers' League.

"July 28th."

Turkish Telegraphs.—It is announced that the Turkish Government has decided to establish a telegraph line between Constantinople and Fao, a distance of 3,018 kilometres. The work will, it is estimated, occupy two years.

Wireless Telegraphy.—A practical demonstration of wireless telegraphy was provided on Thursday last week, by Marconi's Wireless Telegraph Company, on board the *Koh-i-noor*, which was fitted up for the purpose of communication with Southend, Ostend, &c. A large party, including Mr. Seddon, Lord Charles Beresford, Sir E. Sassoon, the Agents-General for several of the Colonies, and other distinguished gentlemen, travelled down to Margate, and witnessed the demonstration.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 8th. Underground high pressure and low pressure cable system (three-phase, direct and telephone). See "Official Notices" July 4th.

Austria.—August 25th. The Austrian State Railways Administration, Pilsen, require the supplies of arc and incandescent lamps and cables for lighting purposes. Offers should be received before August 25th.

Belgium.—August 11th. The Provincial Government Authorities at Liège are inviting tenders until August 11th, for the construction and working of an electric tramway between Seraing and Val St. Lamberts. Particulars may be obtained from, and tenders are to be sent to, Le Gouvernement Provincial, Liège.

Bexley.—August 9th. Cables, switchboards, battery, booster, rotary converter and motors, for electric lighting and traction. See "Official Notices" July 25th.

Brussels.—August 6th. The Société Nationale de Chemin de Fer Vicinaux, Brussels, will on this date consider offers for supply and erection of aerial feeders on the Grâce-Berleur, Hollogne-aux-Pierres section, and from Sainte Walburge to Vottem.

Clinton and Cresswell.—August 2nd. The P.C. want tenders for lighting plant for the above villages. Apply W. G. Moorby, Clerk to the Council.

Coventry.—August 5th. Electric motors to be let out on hire by the Corporation. See "Official Notices" July 25th.

Dresden.—October 1st. A competition for a safety apparatus in connection with the working of electric tramways will be decided on the date mentioned by the Communal Administration of the town of Dresden (Saxony). Three prizes of 5,000, 3,000 and 2,000 marks will be awarded.

Dundee.—August 1st. Machine tools for electrical power station. Apply to Electrical Engineer, Dudhope Crescent Road Works.

Ilford.—August 19th. Combined watering and sweeping car with equipment. See "Official Notices" July 25th.

Kala Lumpur (Selangor State).—August 21st. Two 600-H.P. turbines, two 400-KW. three-phase generators, switchboard, motor-generators, poles, wire, &c., for transmission line, arc and glow lamps, &c., for the Crown Agents for the Colonies. See "Official Notices" July 11th.

King William's Town (Cape Colony).—September 1st. Sealed tenders for electric lighting plant, &c., as per specifications, will be received at the office of the King Electric Lighting and Cold Storage Company, Limited, King William's Town, Cape Colony, until noon on Monday, September 1st, 1902.

Launceston (Tasmania).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Leicester.—September 3rd. Tram rails, points, crossings, conduits, cables, overhead equipment, bonding, boilers, engines, generators, and other power station plant; also electric cars for the Corporation. See "Official Notices" July 18th

Malvern.—August 23rd. Lancashire boilers, engines, alternators, cables, transformers, switchboard, &c., for the Council's electricity supply scheme. See "Official Notices" July 11th.

Manchester.—August 2nd. Quick-break switches for tramways department. See "Official Notices" July 25th.

N.E. Railway.—October 7th. The directors are inviting tenders for the complete electrification of about 37 miles of standard gauge (double track mostly) line in the neighbourhood of Newcastle. The contract is divided into two sections—(1) electrical equipment of coaches and permanent way; (2) high-tension cables and sub-station equipment. For further particulars see our "Official Notices" July 25th.

Newport.—August 20th. Electric generating plant and wiring, &c., for the new lunatic asylum at Caerleon. See "Official Notices" July 25th.

Northfleet.—The U.D.C. is desirous of entering into a contract with some company for the working of its electric lighting order. See "Official Notices" July 25th.

Pemberton.—August 20th. Complete electrical installation (boilers, engines, dynamos, &c.), cables, rails, &c., and overhead equipment. See "Official Notices" to-day.

Roumania.—September 3rd. The municipal administration of Calarasi-Stirbey (Roumania) is prepared to receive tenders for the concession of establishing and working the electric lighting service of the town.

Rugby.—August 20th. One 150-KW. and one 60-KW. high speed steam three-phase alternators; switchboard, mains, lamps, and meters for the U.D.C. See "Official Notices" to-day.

Servia.—August 13th. Tenders are being invited until August 13th by the municipal authorities of Nisch for the establishment of a central station for the electric lighting of the town.

Spain.—August 10th. The municipal authorities of Trujillo are inviting tenders until August 10th for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Trujillo.

Stockport.—August 4th. Ten double-deck cars complete. See "Official Notices" July 25th.

St. Petersburg.—August 14th. Conduits for the municipal telephone system. See "Official Notices" July 25th.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

Warrington.—August 6th. Cables for municipal electric tramways. See "Official Notices" July 25th.

Wolverhampton.—August 13th. Complete electric light installation for new union workhouse. See "Official Notices" July 25th.

Youghal Asylum (Co. Cork).—August 12th. Steam dynamos, battery, switchboards, wires and fittings. Particulars from Mr. H. A. Cutler, Municipal Buildings, Cork.

CLOSED.

Bexley.—Messrs. Hadfields are to supply the points and crossings for the tramways here; and the boilers are to be made by Messrs. Fraser, of Millwall.

Bristol.—The Electricity Committee has accepted the tender of the B.I.W. Co, for the supply of cable for extending the power mains, at £6,080, and that of Messrs. Dick, Kerr & Co., for a dynamo, at £840.

Canning Town.—A contract has been given to Messrs. Peirson & Co., of St. Dunstan's Hill, E.C., for the constructional steelwork for the new generating station, Canning Town, E., comprising roofs, stanchions, girders, coal bunkers, and complete electric coal-handling and transporter plant, at £6,775.

Dundee.—Messrs. G. H. Nicoll & Co., of Dundee, have been awarded the contract for the generating plant for the Sanitorium.

Heckmondwike.—The U.C. has accepted the tender of Messrs. Bennis & Co., for the supply of an ash elevator for the electric light works, and that of Messrs. Dick, Kerr & Co., Ltd., for the paving of Westgate and High Street.

Manchester.—The Corporation Electricity Department have accepted the tender of Messrs. Rowland Carr & Co., of London, for the supply and delivery of the whole of the bitumen required by them for electrical purposes for the year ending June 30th, 1903.

London.—The following tenders have been received by the London County Council for the supply and erection of a 25-ton crane at the temporary power station at Loughborough Junction and for three 10-ton hand cranes for use at three of the sub-stations to be erected in connection with the tramways:—

J. Hitchen & Son, Halifax	£1,387
(alternative) (accepted)	1,447
J. Larmuth & Co., Salford	1,745
C. & A. Musker, Ltd., Liverpool	1,787
Carrick & Ritchie, Edinburgh	1,928
Morris & Bastert, Loughborough	1,962
Higginbottom & Mannock, Ltd., Manchester	1,966
A. Chaplin & Co., Glasgow	1,989
J. Booth Bros., Ltd., Rodley	1,995
Thos. Broadbent & Sons, Ltd., Huddersfield	2,000
Rushworth Bros., Colne	2,086
J. M. Henderson & Co., Aberdeen	2,144
Craven Bros., Ltd., Manchester	2,370

The manufacture of certain parts of the crane girders is to be sublet to C. C. Dunkerley & Co., of Manchester, and that of the electrical equipment for the large crane to the British Thomson-Houston Company.

The lowest tenders submitted to the London County Council by eight firms for the supply of 80 electric cars for the Streatham tramways are as follows:—

Name.	Price.	Period for delivery.	Proposed sub-contractors. Truck.	Body.	Plough.	Equipment and motors.
Witting Bros., Limited	£46,162	20 weeks	Brush Co.	Milnes & Co.	Electricité et Hydraulique, Chasterol	Electricité et Hydraulique
Dick, Kerr & Co. (accepted)	£47,680	24 „	Brill Co.	Electric Railway and Tramway Carriage Co.	J. G. White & Co., London.	English Electric Manufacturing Co.
G. F. Milnes & Co.	£47,855	17 „	None	None	Do.	British Thomson-Houston Co
British Thomson-Houston Co.	£48,288	21 „	European McGuire Co.	Milnes & Co.	Do.	None.
British Electric Car Co.	£49,907	26 „	None	None	Do.	British Thomson-Houston Co
Siemens & Halske	£49,800	40 „	Brill Co.	Milnes & Co.	None	None.
British Westinghouse Co.	£50,128	20 „	Brill Co. or European McGuire Co.	Do.	J. G. White & Co., London.	None.
Brush Company	£52,788	26 „	None	None	Do.	None.

The Highways Committee, who stated that the tenders had been considered by the tramway manager, reminded the Council at Tuesday's meeting of the recent acceptance of the offer of Messrs. Dick, Kerr & Co, for the cars for the Tooting tramways, and in the report then presented it was pointed out that one of the principal reasons which led Prof. Kennedy to recommend the adoption of the cars proposed by that company was the superiority, for the Council's purposes, of their electrical equipment and motors. The manager was also of opinion on the present occasion that the motor and electrical equipment submitted by the same company was preferable to that specified in the lower tenders, and he considered it essential that the further supply of cars should have the same type of plough as those for the Tooting lines. It would be seen that Messrs. Witting Bros. in their lowest tender specified a different make of plough, and although they had sent in a tender in which the White plough was provided for, this was only £94 lower in amount than that of Messrs. Dick, Kerr & Co. The Committee for these reasons recommended the Council to accept the tender of the latter company, and to allow of the sub-letting of the parts as indicated in the list of tenders. The recommendation was agreed to without discussion.

The undernoted tenders have been submitted for the supply of a motor-generator for the Horniman museum:—

Siemens Bros.	£52 10 0
Eastop & Co.	58 0 0
Electric Construction Company (accepted)	62 10 0
General Electric Company	68 5 0
Laurence, Scott & Co.	69 0 0

Salford.—The T.C. has accepted the tender of Messrs. Ferranti, Limited, for the supply of resistances for the traction switchboard at the Strawberry Road station for £288, and that of Messrs. Graham, Morton & Co., Ltd., for a dozen coal chutes for the Strawberry Road works (£298).

Swansea.—We understand from Mr. C. A. L. Prusmann, the borough electrical engineer, that our notice on p. 114, July 18th issue, regarding the cables contract is inaccurate. The matter has not yet been settled.

Sydney (N.S.W.).—We learn with interest and satisfaction that the electric lighting plant for the Sydney lighting station is to be made in this country, and we hope it points to greater activity before English electrical manufacturers in the Colonies. Messrs. Dick, Kerr & Co., Limited, have secured the contract for the supply of the whole of machinery for the Corporation lighting station. Alternating three-phase current is to be generated at the central station, and transmitted at a pressure of 5,000 volts by means of underground cables to sub-stations, at two of which it is to be converted into continuous current to supply the three-wire network of distributing mains. At four other sub-stations static transformers are to be installed, reducing the E.M.F. to 240 volts between each of the outer conductors and the central point of the three-phase star-connected system of conductors. The distributing mains will, in this case, be four-core, the lamps being connected in approximately equal numbers between each of the three outer conductors and the conductor which is connected to the central point of the star; this point is also to be connected to earth, at each of the sub-stations. Messrs. Preece & Cardew are the consulting engineers, and, as our readers will remember, they devised the scheme after a personal investigation by Major Cardew into the whole of the local conditions. The plant which Messrs. Dick, Kerr & Co., Limited, are supplying comprises five boilers of the water-tube type (Babcock and Wilcox), each capable of evaporating 10,000 lbs. of water per hour. There are, in addition, mechanical stokers, economisers, superheaters, feed pumps, feed water storage tank, condensers, and various air and circulating pumps. There are three steam alternators, each consisting of a steam engine coupled direct to a three-phase alternator and exciter. Two of the steam alternators are each of 600 KW. capacity, the third machine having an output of 300 KW. The machines will be each capable of giving considerable overload for some time. The engines which will be supplied for this contract are of the Ferranti type, and the generators will be manufactured at Preston, and will be of the standard design adopted by Dick, Kerr & Co., Limited, in their machines for the London County Council, Fulham, and other contracts. The contract also covers the whole of the pipe work, travelling crane, and storage battery. The sub-station plant is included in the same contract, and comprises five sets of motor-generators, each set being capable of giving an output of 150-KW. continuous current. Three of the sets consist of an induction motor driving two 75-KW. continuous-current generators, the other two sets consisting of an induction motor driving a 150-KW. continuous-current dynamo. A number of static transformers are also being supplied by Dick, Kerr & Co., Limited, under the same contract. The main switchboard will be of the Ferranti type. It may be observed that the contract provides for the erection of the plant, the total amount of the contract being between £50,000 and £60,000. The same firm are supplying large plant all over the world, their contracts comprising the erection of generating plant at Cape Town, the construction and equipment of electric tramways in Calcutta and Hong Kong, and now the complete equipment of the Sydney Corporation Lighting Works. As might be expected, competition for such an important contract has been of the keenest description, and the result is especially satisfactory when one remembers how strong American manufacturers have been in Australia in electrical work up to the present.

NOTES.

The B.E.T. Companies' Staff Dinner.—On Friday the 25th ult., the staff dinner of the British Electric Traction Company and associated companies took place at the Criterion Restaurant, the chairman being Mr. Emile Garcke, who was supported on his right by Sir Chas. Rivers Wilson, the chairman of the British Electric Traction Company, and on his left by Lord Vaux of Harrowden, the chairman of the Brush Electrical Engineering Company. There were about 250 present, representing some 70 undertakings, while the visitors included representatives of the electrical and financial press, and of the chief electrical engineering companies of the country. The dinner was preceded by a reception of the guests by Mr. Garcke; this afforded a good opportunity for those who had come up from distant parts of the country, to have a chat with old friends.

After the usual complimentary toasts, that of the Houses of Parliament being proposed by Mr. Sydney Morse, and responded to by Lord Vaux, Sir Ernest Spencer, M.P., and Mr. L. A. Atherley-Jones, K.C., M.P., the chairman proposed "The British Electric Traction Companies," coupled with the name of Sir Chas. Rivers Wilson. In the course of his speech he quoted some striking figures, showing the progress and prosperity of the various undertakings. There were some 16,000 shareholders and debenture holders interested in the various companies, while the total capital was about £6,500,000. The B.E.T. Companies afforded a large field for labour, as could be seen from the fact that they employed over 10,000 people, and that the annual wages bill amounted to more than £700,000. Further, though some people made much of an alleged hostility between municipalities and themselves, he would like to point out that they had dealings with over 200 local authorities with whom they were on excellent terms. They would all agree that the companies were doing good work for the public, when he told them that the annual traffic receipts were a million and a half sterling, while in a year they carried the entire population of the country eight times over. He denied the charge that they were merely company promoters, and pointed out that no company floated by them had been left to sink or swim by itself, as the parent company had always held a large financial and administrative interest. Further, they never took up an Act or order which they did not intend to carry out, and they had already expended £3,000,000 on engineering works throughout the country. With a few words on the rapid progress of the electrical industry, and the great potentialities of electricity, he concluded.

Sir Rivers Wilson responded briefly, and said that the present gathering afforded ample proof of this progress in matters connected with electricity. After the toast "The Visitors" had been proposed by Mr. Stephen Sellon, in his own inimitable way, and responded to by the Hon. Robert P. Porter, of the United States, who, by the way, was emphatic in his denunciation of the heresy that British industrial supremacy is on the wane, or that there is any reason here for what he termed industrial despondency, Sir Rivers Wilson proposed "The Chairman"; this toast was drunk most heartily, and the gathering then broke up.

Mr. Garcke's eloquent speech, of which, owing to the exigencies of space we have given but the briefest outline, produced a great impression, and it was pleasant to note the mutual confidence and esteem which so plainly exists between the managing director of the B.E.T. Company and the representative employés of that great undertaking. With such a magnetic personality, no wonder that Mr. Garcke can imbue his subordinates with the determination to succeed, and the next 12 months will doubtless afford further opportunities for his unceasing activity. Music and song helped to enliven the more serious proceedings of the evening, which was a huge success from every point of view, and upon which everybody connected with the company may be warmly congratulated. But, Mr. Garcke, please do take that holiday to which you are so well entitled, and upon which your best friends so insist. *Verb. Sap.*

The Institution of Junior Engineers.—The summer meeting of this Institution commences on August 11th, the North-East Lancashire district being the locality to be visited, with Blackpool as headquarters. The meeting opens with an excursion to Barrow to inspect the works of the British Griffin Chilled Iron and Steel Company, the Barrow Hematite Steel Works, and the Kellner-Partington Paper Pulp Works. On Tuesday, after being received by the Mayor of Blackpool, the power station of the Blackpool and Fleetwood Tramroad Company, and the Lancashire and Yorkshire Railway grain elevator at Fleetwood are to be seen. On Wednesday an excursion will be made to Furness Abbey, Lake Windermere, &c., and on Thursday the members travel to Preston to visit the cotton spinning and weaving works of Messrs. Horracks, Crewdson & Co., the Electric Tramway and Railway Carriage Company's works, and those of the English Electric Manufacturing Company. Friday will be devoted to an inspection of the engineering features of the Blackpool Tower, &c., and in the evening the summer dinner of the Institution takes place at the Queen's Hotel, South Shore, Blackpool. Mr. F. S. Pilling, M.I.E.E., 39, Victoria Street, Westminster, has been appointed hon. local secretary of the meeting.

Electrical Engineers, R.E. (Vols.).—Two companies consisting of four officers and 100 men are expected to arrive home from South Africa on Saturday. The members of the corps are to parade at Headquarters at 10.30 a.m. on Saturday to receive them. The drum and fife band will be in attendance and will play the detachment from Waterloo to Headquarters.

Business, not Philanthropy.—In our critical article of October 14th, 1901 (Vol. xlix., p. 542) on the "National Industrial Association," we ventured, in discussing the subject of profit-sharing, to make the following remark:—"In the minds of many people the idea (profit-sharing) suggests philanthropy or charity, but it is neither; it is a method of conducting business. In some cases a portion of the profits has been set aside to provide comforts, amusements, or recreations for the employés. The towns of Saltaire, Port Sunlight, and Bournville are cases in point, and whilst, in the popular mind, Sir Titus Salt, the Lever Brothers, and the Cadburys may rank as philanthropists, they would be the first to admit they were business men first, and that the apparent philanthropy was an excellent plan for conducting business profitably." We are pleased to have so striking a confirmation of our views as is afforded by the speech delivered by Mr. W. H. Lever himself at the conference of the Garden City Association, held last Saturday at the "garden" village of Port Sunlight. In this speech he disclaimed any suggestion of philanthropy in regard to the village, and added that the relation between master and man must be a strictly business one. He further characterised the "Ca' Canny" policy as a mistaken and a fallacious notion, which only served to drive trade to other countries. It will be a good day for the trade of this country when both workmen and labour leaders take this to heart.

Obituary.—We learn with great regret that Mr. Arthur Dennis, of Messrs. W. F. Dennis & Co., died suddenly on Sunday evening at his residence at New Barnet, after a few days' illness, of peritonitis. Mr. Dennis was senior partner in the above firm, who have been for many years past, and are still, the sole agents in this country for the well-known firm of Felten & Guilleaume, Carlswerk, Actien-Gesellschaft, Mulheim-on-Rhine, also the Antwerp Telephone and Electrical Works, and the Pather Iron and Steel Company, Wishaw. We understand that the business of W. F. Dennis & Co., will be carried on as heretofore.

The daily press announces the death of M. Gustave Trouvé, a well-known French electrical engineer. He died on Monday, in Paris, in his sixty-third year. Among his numerous inventions were an incandescent electric lamp destined to explore the human body, an apparatus for fishing by electricity, luminous fountains without water, and electric mining lamps.

The Arc Works.—On Tuesday last a party of engineers, technical pressmen, and others journeyed to Chelmsford to visit the Arc Works of Messrs. Crompton & Co., Limited, and to inspect some plant for Calcutta, then under test. This consisted of two multipolar generators, each capable of giving an output of 800 KW. at a speed of 230 revolutions per minute. As, however, we shall deal fully with the objects of the visit in a future issue of the REVIEW, we refrain at the moment from entering upon any further particulars concerning many matters of interest to the electrical engineering industry generally.

Marconi and the Coherer Patents.—Following our note of last week under this heading, the following extract from the *Saturday Review*, of 26th ult., may be of interest, coming, as it does, from the seat of war so to speak:—"A startling *dénouement* has followed upon the correspondence in our columns between Prof. Silvanus Thompson and Mr. Marconi. It will be remembered that in May last Prof. Thompson stated, with some show of circumstance, that the feat achieved by Mr. Marconi in detecting telephonically in Newfoundland signals sent out from Cornwall, had been accomplished not by any devices invented by Mr. Marconi, but by a different invention from that described in the patent for his system, and in fact invented by some person whose name had been withheld from the public. Mr. Marconi replied at the time with an assertion that the Professor had been led into absolute and gratuitous untruth. There has since been a good deal published in the *Times*, as well as in the technical press, concerning a dispute between two officers of the Royal Italian Navy, named Castelli and Solari, as to which of them was the real inventor of this admirable appliance. Certain it is that Solari, a year ago, brought personally to Marconi the particular apparatus used by Marconi in Newfoundland, and then returned to Italy. The Official Journal of the Patent Office of July 16th contains a brief notice of a very unusual character, which throws light on the proceedings that followed. It announces that Guglielmo Marconi, who, on September 10th, 1901, had filed a patent in his own name for this invention, now seeks leave to amend his application, 'by converting it into an application for a patent for an invention communicated to him from abroad by the Marquis Lingi Solari, of Italy.' So it appears that Prof. Thompson's statement now receives official confirmation on both heads, since the invention is a different one, requiring a new patent, and the names of Solari and Castelli had certainly been suppressed until Prof. Thompson's revelation. But what are we to think of Mr. Marconi's denials? What has he to say for himself?"

American Engine-Builders.—The Engine Builders' Association of the United States held a very successful semi-annual meeting at the Schenley Hotel, Pittsburg, Pa., recently. A paper on "Engine Forgings" was read by Mr. H. F. J. Porter. Papers were also read by Mr. E. M. Tingley, of Pittsburg, on "Engine Requirements for the Parallel Operation of Alternators"; by Mr. H. M. Longwell, of Pittsburg, on the "Requirements for the Paralleling of Alternators as Viewed by the Engine-Builders"; and by Mr. John B. Berryman on "Piping Material for Steam Plants." Is there not room for an Engine-Builders' Association of the United Kingdom?

Personal.—Mr. H. S. Deacon, who has hitherto held the appointment of secretary and general manager of Crypselco, Limited, Bedford, has now been elected to a seat on the board and appointed managing director.

The German Emperor has accorded the distinction of the Red Cross (Third Class) upon Mr. Edwin O. Sachs, chairman of the British Fire Prevention Committee.

We learn that Mr. William Young is severing his connection with the Edison & Swan Co., after being 18 years in their employ. He entered their service in 1884, and was for some years managing and confidential clerk at their factories, and latterly assistant to the general manager and sales manager respectively, at the company's commercial offices.

Mr. E. Lonsdale Pope, resident engineer at Callender's Cable and Construction Co., has been appointed distribution engineer in the tramways department of the London County Council at a salary of £350 per annum. Mr. A. C. Devey, outside superintendent to the British Insulated Wire Co., and Mr. L. R. Lee, chief mains engineer to the Manchester Corporation tramways, were the other two candidates in the final list, whilst the total number of applications received for the position was 81.

Moving Sidewalk.—A well-backed scheme is on foot for putting an electric moving sidewalk on Brooklyn Bridge. It is said that it will be put in operation within a year.

Marriage.—On July 24th at St. Mary-le-Tower, Ipswich, the marriage was solemnised of Mr. Henry Edward Mordaunt Kensit, son of the late Lieut. H. E. Kensit, 19th Hussars, to Mildred, daughter of Allen Goodwyn, of Stapenhill, Ipswich.

The G.E.C. Fire.—The jury which has been sitting for several weeks inquiring into the cause of the disastrous fire at the General Electric Company's premises in Queen Victoria Street, E.C., finished its sittings on Tuesday. We give the following extract from the *Times* report of the questions put to and answers made by the jury:—

Did the private fire brigade of the General Electric Company materially contribute to the extinguishing of the fire?—No.

Were reasonable precautions taken against fire by the General Electric Company, having in view the number of electric lighting lamps and wires in use and the amount of inflammable material about the premises?—We say No.

Do you think that the premises of the General Electric Company, Nos. 67, 69, and 71, Queen Victoria Street, constitute a workshop within the definition of the Act?—We say yes, most decidedly.

Do you think that had proper structural exits been provided in the roof or elsewhere this loss of life would have been altogether or partly prevented?—We say yes, altogether prevented.

Was the sanction given by the district surveyor, Mr. Power, to the structural changes that connected 67 to 69 in your opinion legal or otherwise, in view of the fact that the General Electric Company's occupation of No. 67 was only partial?—We say illegal.

Was there any neglect of legal or other obligations or duties on the part of the following:—(1) The General Electric Company; (2) the Metropolitan Fire Brigade; (3) any of the various officials who have given evidence; (4) any of the various authorities alluded to in the course of evidence; if any negligence has been committed, to what degree does that negligence, in your opinion, amount?—We say, with regard to the General Electric Company, there was gross legal negligence, but not criminal. With regard to the Fire Brigade, "No, considering the appliances at their disposal." (3) We say Yes; we consider the factory inspector failed to properly represent to the Home Office the nature of the work carried on by the General Electric Company through not making sufficient inquiry. We think the district surveyor is to blame for his interpretation of the term "wholly occupied."

Do you consider the entrance to No. 71 sufficient for the employés at 67, 69 and 71?—We say no, it is not sufficient.

The foreman said the jury thought the cause of the fire unknown, and as to who was responsible, the jury could not say. They wished, however, to add the following riders:—(1) We consider that the Watling Street Station is totally inadequate to meet the demands of the district in which it is situated, and that it should be immediately reconstructed a first-class fire station. (2) We consider that the London Building Act, 1894, should be made retrospective as regards life-saving. (3) We consider that the General Electric Company, by evading the Factory Act and misleading the district surveyor, render themselves responsible for the loss of life. (4) We give unqualified praise to the Metropolitan Fire Brigade and the Salvage Corps, and we consider that, as usual, the City Police did their duty exceedingly well.

Summer Conference of the Mechanical Engineers.—On the 29th ult. the Summer Conference of the Institution of Mechanical Engineers was opened at Newcastle-on-Tyne. Mr. Charles Hopkinson, of Manchester, read a paper on pumping plant for condensing water especially applicable to electric power stations. It consisted of a centrifugal pump and turbine by Messrs. Mather and Platt, and although the initial cost was great, yet he contended it was profitable. Two papers in connection with electric works in the city were also read, one by Mr. W. D. Hunter, of Newcastle, on the Newcastle and District Electric Lighting Company's power stations, in the course of which he spoke of the growth of the undertaking; and Mr. W. B. Woodhouse then described the Neptune Bank station of the Newcastle Electric Supply Company.

Correction.—We are informed that the Corporation of Bangor is not contemplating extension of the electricity works, as reported in our issue of the 18th ult. There will be no need to consider the matter until next spring.

Tramway Plant for Wellington.—We learn by last mail that the Wellington City Council (N.Z.) has decided to call for tenders for the materials and plant to be used in connection with the installation of electric tramways in that city from London. Mr. W. R. Wright, who was recently appointed to carry out the work, has been instructed to proceed home for the purpose of calling for tenders as soon as the "Order in Council" is granted. It is expected that he will be associated with a small advisory body to be formed in London.

Appointments Vacant.—Station engineer, charge engineer, and others for the Woolwich Electricity Department; an assistant engineer is wanted at Oldham at a salary of £100; the Colchester B.C. requires a chief assistant at £130.

THE CENTRAL STATION ENGINEER.

On the occasion of the departure of Mr. O. A. Pilcher, the chief assistant electrical engineer of the County Borough of Blackburn, to take up his new position of engineer and manager to the Ilkeston Tramways, he was presented by the staff of the electricity and tramways departments with a travelling bag, dressing case, &c. Mr. Giles, in making the presentation, said he was exceedingly sorry to lose Mr. Pilcher.

An interesting ceremony took place at the Bolton Corporation Electricity Works on Friday afternoon, when, on the departure of Mr. F. H. Corson, one of the engineers, for a more lucrative position under the Blackburn Corporation, he was made the recipient of a handsome silver photograph frame, hand-bag, &c. The chief engineer, Mr. A. A. Day, in making the presentation on behalf of the staff, expressed himself as to Mr. Corson's value and ability, thanking him for his help in bringing the station to its present coveted position, and wishing him every success in his new sphere, this being unanimously seconded by the staff.

Mr. Walter J. Bache, resident engineer, was presented last week with a handsome case of cutlery and plate by the committee and staff of the Gloucester Corporation Electricity Works, upon the occasion of his marriage.

The staff and workmen at Newport Corporation Electricity Works on Tuesday presented Mr. C. D. Copland with an illuminated address and a handsome present on the occasion of his leaving. Mr. Copland has been borough electrical engineer for the past eight years.

The York City Council has decided to increase the salary of the electrical engineer, Mr. Midgley, from £300 to £400 a year.

The Darlington Town Council on July 23rd confirmed the recommendation of the Electric Light Committee to increase the salary of the electrical engineer (Mr. Lunn) by £50 a year, making it £250, on condition that he agrees to remain in the service of the Corporation for a period of three years.

The Wigan Electric Lighting Committee has confirmed the recommendation that Mr. Jas. Slevin, tramway traffic manager for the Corporation, be appointed borough electrical engineer.

NEW COMPANIES REGISTERED.

Electrical Publishing Company, Limited (74,449).—This company was registered on July 24th, with a capital of £14,500 in £1 shares (4,500 preference), to take over and work a new publication called the *Electrical Magazine*, founded by T. Fielden (vendor to this company), and to carry on the business of proprietors, printers and publishers of newspapers, periodicals, magazines, books and other literary works. The first subscribers (each with one share) are:—T. Fielden, Winchendon House, Watford, journalist; C. H. Fielden, Oakover, St. Alban's Road, Watford, journalist; R. Thomas, 27, Chancery Lane, W.C., insurance inspector; R. V. Beveridge, Crown Court, Chancery Lane, W.C., journalist; W. D. Hall, 30, Essex Road, Watford, printer; W. N. Twelvetrees, 31, Louisville Road, Upper Tooting, S.W., consulting engineer; and G. W. de Tunzelmann, 82, Victoria Street, S.W., consulting engineer. Minimum cash subscription, £2,000. The number of directors is not to be less than three nor more than seven; the first are T. Graham, C. B. Crawshaw and T. J. V. Fielden (permanent director and chairman). Registered office, Clun House, Surrey Street, Strand, W.C.

CITY NOTES.

The Direct United States Cable Company.

The fiftieth ordinary general meeting of this company was held on Tuesday at Winchester House, Old Broad Street, Mr. E. M. Underdown, K.C., presiding.

The Chairman, in proposing the adoption of the report, said that the revenue for the six months to June 30th, after deducting outpayments, amounted to £46,610. The working and other expenses, including income-tax, absorbed £21,516, leaving a balance of £25,094 as net profit, making with £3,350 brought forward from the previous half-year, a total of £28,444. That had been appropriated as follows:—The interim dividend of 3s. per share, paid March 31st, £9,106; proposed final dividend for the financial year 3s. a share and a bonus of 1s., £12,142; they proposed to transfer £5,000 to the reserve account, which would leave a balance of £2,196 to carry forward. The revenue showed a small decrease—£4,039, as compared with the corresponding period of last year, owing to the additional cables now in operation. There were at present 14 effective cables working the North American business. The working expenses in London remained practically the same as previously, and

also at the stations. There was a small increase in respect of foreign agencies. It was necessary to keep someone in foreign places to look after their business, because great energy was shown by their rivals in collecting business, and they thought that that expense was well incurred. The reserve fund was in a very satisfactory position. It had been credited with £7,366 of interest on investments, and with £5,000 transferred from the revenue account, and it now amounted to £460,383 at cost, but the actual value of the securities was larger. The question of the reserve brought him to a very interesting and pleasing incident. As they knew they used the reserve fund for effecting any repairs or renewals, and they replaced the money so used as they were able. Very singular to relate, during the whole of the past 12 months, and up to the present time, they had not had to spend anything upon repairs or renewals to their cable. That was a very remarkable thing for a cable that had been down for so many years. Their investments had been increased by £11,346. If they took the whole year, the receipts had amounted to £96,199, less expenses £43,074. They, therefore, had £53,125 to be dealt with, and they had paid in dividends £39,461, and placed to reserve £16,000. The whole question of cable communication had been before a Departmental Committee, and had been most thoroughly examined into. Most of them had been before that Committee, and had given evidence in defence of their various interests, and it was satisfactory to know that in the report just issued, the Committee stated that the Atlantic Companies had not formed the subject of public controversy; they had received no subsidies, and they provided under the influence of competition, an efficient service at a low rate, and no complaints had been laid against them. With respect to wireless telegraphy, he would only reiterate what Sir John Wolfe Barry had said on the subject to the proprietors of the Eastern Extension Telegraph Company last week. They knew perfectly well that those inventions might be of value, but it seemed to have escaped the attention of some of their rivals, that if they were of value, there was nothing in the world to prevent themselves, and other cable companies who had large staffs, from making use of them, in so far as they might be useful. He recently had an interview with Lord Kelvin, who held a very strong opinion that however valuable wireless telegraphy might be for certain purposes, it could not affect the transmission of messages over great distances through cables. Therefore, he did not think there was any ground for nervousness on the part of the holders of cable companies' stock.

Sir James Pender, Bart., seconded the resolution, and the report was adopted.

Central London Railway Company.

The directors' report for the half-year ending June 30th, 1902, to be submitted to the meeting to be held at the Holborn Restaurant on Tuesday, August 5th, reads as follows:—

"The directors have pleasure in submitting to the proprietors the following report and statement of accounts for the half-year ending June 30th, 1902. The sum of £107,099 3s. 8d. has been received during the half-year on account of debenture stock, including the premium thereon, and the amount expended on capital account has been £21,537 3s. 6d. The receipts from all sources on revenue account have amounted to £185,118 4s. 4d., and the working expenses to £93,099 10s. 5d., leaving a balance of £92,018 13s. 11d., as shown in the net revenue account. The number of passengers carried since the opening of the railway is as follows:—

Five months ending December 31st, 1900	14,916,928
Half-year ending June 30th, 1901..	20,988,739
Half-year ending December 31st, 1901	20,802,650
Half-year ending June 30th, 1902..	22,679,884
Total number carried	78,934,645

Compared with the corresponding period in 1901, the company conveyed during the past half-year 2,493,595 more passengers, and during the week in which it was intended to hold the Coronation the large number of 1,256,000 passengers was carried over the railway. These satisfactory results clearly indicate the capacity and utility of the undertaking. After providing for interest on debenture stock, the net revenue account shows a balance of £82,603 8s. 11d., including the amount of £5,874 7s. 7d. brought forward from last half-year. The directors recommend that out of this sum interim dividends be declared at the following rates of distribution:—On the undivided ordinary stock at the rate of 4 per cent. per annum. On the preferred ordinary stock at the rate of 4 per cent. per annum. Under the Company's Acts the dividend on the deferred ordinary stock is not payable until the result of the working of the year ending December 31st has been ascertained. A sum of £9,994 12s. 5d., representing the deferred dividend, and being part of the general balance of £35,598 1s 4d., has therefore been carried to the 'dividend suspense account (divided stock),' and will be dealt with at the end of the year, leaving a net balance of £25,603 8s. 11d. The results for the half-year would have sufficed to pay an increased dividend, but in view of the pending liabilities for the expenses in connection with the 'Vibration' inquiry, and with the promotion of the Bill referred to below, as well as provision for reserve, the directors have thought it expedient to carry forward the above-stated sum. The Bill entitled the 'Central London Railway (New Lines) Bill,' which was submitted to the proprietors and approved at the last half-yearly meeting, for the construction of a railway from Shepherd's Bush, by way of Hammersmith, Piccadilly and the Strand, to the City, forming, with the existing line, a circular route through the heart of London, was considered by a Committee of the House of Lords in the present session, but this proposal was rejected, although it was supported before the Committee by the Corporation of London and the London County Council. The Committee finally approved a combination of opposition schemes consisting of railways (1) from Hammersmith to Hyde Park Corner, (2) from Hyde Park Corner to Ludgate Circus, (3) from Ludgate Circus to Palmer's Green. The company's Bill, so far as it authorises the acquisition of property adjoining the Marble Arch station, and an increase of capital powers, has passed both Houses of Parliament, and now awaits the Royal Assent. The work of providing additional lifts at Shepherd's Bush to accommodate the traffic at that station is progressing satisfactorily, and it is hoped that two of the lifts will be available for service in September next. It will be remembered by the proprietors that a committee was appointed by the Board of Trade in the early part of last year to inquire into the cause of vibration on the Central London Railway, and that their report was issued in January last. It was stated by the experts who were appointed, that the amount of vibration caused by the running of a motor-car train was very slight, compared with that of a train hauled by one of the company's electric locomotives. Your directors therefore determined to act upon the recommendations contained in the report, and to remove all cause of complaint by adopting the motor-car (multiple unit) system. The necessary motor-cars have been ordered, and it is anticipated that by the end of this year most of them will have been delivered and put into service. The directors have appointed Viscount Esher, 2, Tilney Street, Mayfair, W., a director of the company, and a confirmatory resolution will be submitted to the proprietors at the half-yearly meeting. The directors propose that the dividend shall be payable on and after August 12th next."

Waterloo and City Railway Company.

The report for the half-year ended June 30th last, to be submitted at the meeting on the 7th inst., states that the capital account shows a total outlay of £605,317. The gross receipts of the line, less Government duty, amounted to the sum of £17,204, and the working expenses to £7,715, being at the rate of 44·84 per cent. as compared with 54·78 per cent. for the corresponding period of 1901. The balance available for dividend, after providing for interest on debenture stock, is £8,558, and a dividend at the rate of 3 per cent. per annum on the ordinary stock will absorb £8,100, leaving £458 to be carried forward to next half-year. The directors announce that the accumulated deficiency in net revenue, amounting to £11,907 at the end of last year, has been disposed of in an adjustment of accounts with the South-Western Company. The number of passengers carried during the past six months, exclusive of season ticket holders, was 2,239,394, showing an increase of 105,332 over the number carried in the corresponding period of 1901. The season ticket holders on June 30th last numbered 1,197, as against 1,057 at the end of June, 1901. The working company have recently been enabled, by an altered system of signalling, to introduce a more frequent service of trains, which no doubt accounts, to a large extent, for the satisfactory increase in the traffic.

Metropolitan Railway Company.

The report for the half-year ended June 30th last shows that contracts were let in March last to the British Westinghouse Electric and Manufacturing Company, Limited, for the supply of the complete plant and machinery for the power station at Neasden, and for the sub-station plant and machinery, the whole of which is now being constructed. Plans and specifications have been prepared for the erection of the power station building, and tenders have been advertised for and received, and a contract is now being settled for this work, which will proceed simultaneously with the construction of the electric plant and machinery, so that the whole may be completed in the autumn of next year. A design for new rolling stock, on the corridor principle, has been approved by the board, and a contract for the construction of the trains and motors to be used on that portion of the railway which will be electrically equipped will shortly be let. The question of obtaining a water supply for the power station at Neasden has received the careful attention of the directors. A well has been sunk on land belonging to the company, adjoining the site of the power station, and the result has been entirely successful. The supply of water will, it is believed, be sufficient for the purposes of the power station, and also for the other works at Neasden. The number of passengers carried during the half-year was 44,213,121, and the gross receipts for passengers, goods, minerals and tolls, amounted to £389,645.

Metropolitan District Railway Company.

At a private meeting of preference stockholders of the Metropolitan District Railway Company on Monday, Mr. R. W. Perks, M.P., presiding, a proposal that had been made to the board by the Underground Electric Railways of London was considered. Mr. Perks first of all alluded to the position of the 5 per cent. preference proprietors, whose stock, amounting at the present time to £1,500,000, was receiving no dividend. Having described the conditions under which this stock was issued in the year 1869 at a discount of £548,766, and to the vicissitudes through which the stock had passed, he pointed out that the interest on it rose from a ½ per cent. in 1873 to 5 per cent. in 1878, and said that it continued at the latter rate until 1882, when it again fell away, dropping to *nil* in 1889. From that year the rate of interest rose gradually until 1897, when 3⅜ per cent. was paid, but the dividend had now fallen again to *nil*. The chairman stated that the Underground

Electric Railways Company, which has a subscribed capital of £5,000,000, would be willing, under certain conditions, to guarantee to the preference proprietors 1 per cent. for the first year, 2 per cent. for the second year, and thereafter 3 per cent. in perpetuity, the Underground Company taking any surplus interest that might be earned between the 3 per cent. and 5 per cent., and also having the right to vote in respect of the preference stocks so guaranteed. The offer, he said, was conditional upon three-fourths of the shareholders assenting to the arrangement within the specified time.

The *Financial Times*, commenting upon the matter, says:—"It is obvious that the position of the preference shareholders may be very much improved by the impending electrification of the line, and accordingly the Yerkes-Speyer Syndicate, who hold the preponderance of the ordinary stock, desire to secure the preference vote also, by offering an immediate bird in the hand in exchange for the two in the bush. . . . . The meeting very prudently refused to swallow the proffered gingerbread without careful examination, and appointed a committee of five to confer with the Underground Electric Company's board. We hardly think the committee will be disposed to jump at the terms offered. The Yerkes Syndicate would not be likely to give a 3 per cent. guarantee in perpetuity unless it saw its way to making a profit on the transaction, and it will be difficult to persuade the preference holders that the restoration of the company's fortunes should operate not so much for their benefit as for that of American capitalists—although it is only fair to say that, had it not been for the same American capitalists, they might have had long enough to wait for electrification."

Dublin United Tramways Company (1896).

The report for the half-year ended June 30th last states that the directors have declared dividends for the half-year at the rate of 6 per cent. per annum on the preference shares, and at the rate of 5 per cent. per annum on the ordinary shares. These dividends will absorb £31,912, leaving a balance of £2,015 to be carried forward, after writing off £552, the balance of preliminary expenses, and providing £1,000 in respect of the action of Fitzgerald against the company, the appeal in which is now pending in the House of Lords. The amount claimed against the British Thomson-Houston Company has been debited to capital account. The directors are advised that this will not prejudice the company's claim, and if any sum is recovered it will be credited to the capital account in due course.

Mr. W. M. Murphy presided at the half-yearly meeting held at Dublin on Tuesday, and in moving the adoption of the report, he said the position and prospects of the concern were satisfactory. The feature in the report was the increase in the dividend on the ordinary shares from 4 per cent. to 5 per cent. per annum. There was an increase of £5,120 in the gross revenues, and the net result was that there was £45,220 available, against £39,820 this time last year. The company carried 29½ million passengers in the half-year, being an increase of nearly a million, at an average per head of 1·21d. The local rates and wayleaves amounting together to £15,609 in the half-year, were on a larger scale than in any city in the United Kingdom.

Harrow Electric Light and Power Company.

The annual general meeting was held on Thursday last week at the offices, Mr. C. Colbeck presiding. The report of the directors and the accounts as presented by them were adopted by the meeting, and the final dividend on the preference shares ordered to be paid. No dividend was declared on the ordinary shares, but, as the report proposed, an additional £500 was added to the depreciation fund. The meeting was adjourned to an early date in October for the discussion of other matters.

The Globe Telegraph and Trust Company.

The directors' report reads:—

The balance-sheet and accounts for the year ended July 18th, 1902, with statement of the stocks and shares held by the company at that date, and income received therefrom during the year, are herewith submitted. The net revenue of the company for the year, after deduction of expenses, amounts to £199,370 16s. 9d., and makes, with the balance of £1,101 16s. 7d. brought forward, a total of £200,472 13s. 4d. From this amount there has been distributed the sum of £130,467 2s. 3d. in interim dividends, leaving an available balance of £70,005 11s. 1d. The directors now recommend the payment of a final dividend of 3s. per share on the preference shares, and of 4s. 9d. per share on the ordinary shares, making, with previous distributions, a total dividend for the year of 6 per cent., less income-tax, on the preference, and of 5⅝ per cent. net (against 5½ per cent. for the preceding year) on the ordinary shares, leaving a balance of £1,856 12s. 2d. to be carried forward to the next account. During the year the directors have issued, at a premium, 300 ordinary and 485 preference shares of the company, being part of the issue authorised by special resolution of May 11th, 1875; the proceeds have been, as usual, invested in telegraph securities. For the general convenience, it is proposed that in future the annual meetings of shareholders be held in the month of May, when the directors' report and the accounts for the year ending April 30th will be presented. The next accounts will therefore cover a period of about nine months only.

Great Northern and City Railway Company.

The report for the half-year ended June 30th last, to be submitted at the meeting to-day, states that the railway between Drayton Park and Finsbury Pavement is completed so far as the tunnelling is concerned. The laying of the permanent way and the erection of the stations at Drayton Park, Essex Road, Old Street, and Finsbury Pavement are making rapid progress. The generating station is in a very forward condition, and the British Thomson-Houston Company, under their contract for the electrical equipment, are providing an installation which, it is believed, will embody all the latest improvements. In accordance with the agreement with the Great Northern Railway Company, Messrs. S. Pearson & Son, Limited, under their contract with that company, are pushing forward the works of the extension from Drayton Park to Finsbury Park Station. An agreement has been entered into with the City and South London Railway Company for the joint use with that company of the station at Old Street. The company's Bill, which was explained to, and approved by, the last meeting of shareholders, has passed the House of Lords and the second reading in the House of Commons, and will shortly come before a committee of the latter House.

The Liverpool Overhead Railway Company.

The directors' report, to be submitted at the half-yearly meeting at Liverpool, on Tuesday, August 12th, reads as follows:—

In presenting the half-yearly statement of capital and revenue accounts to June 30th, 1902, the directors have to report that the gross revenue receipts amount to £37,988 0s. 2d., and the working expenses to £29,287 12s. 11d.

The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31st, 1900.	Half-year ending June 30th, 1901.	Half-year ending Dec. 31st, 1901.	Half-year ending June 30th, 1902.
First class	716,095	721,999	708,740	656,756
Second class, including tramways	3,369,883	3,157,111	3,321,856	2,966,690
Workmen (special return tickets)	1,569,571	1,503,114	1,402,858	1,402,976
Total ..	5,655,499	5,382,224	5,433,454	5,026,422

There has been a further falling off in traffic during the past half-year mainly due to the competition of the Corporation Tramways. To render the line more attractive, your directors have decided to accelerate the service, which will reduce the time required to make the journey from end to end from 32 to 20 minutes. The new service will be inaugurated next month. The working of the Crosby, Waterloo and Seaforth Tramways continues to be satisfactory.

Revenue Account.

	£	s.	d.
Receipts from passenger traffic amount to	37,207	7	0
Miscellaneous receipts and interest	780	13	2
	37,988	0	2
Less working expenses	29,287	12	11
	8,709	7	3
Deduct interest on mortgage debentures	3,400	0	0
	5,309	7	3
Add balance brought forward, December 31st, 1901 ..	3,692	12	4
„ amount transferred from Dingle Fire Contingency Account	300	0	0
Leaving available for dividend	9,292	19	7

Out of this balance your directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after August 15th, next:—

5 per cent. per annum on preference shares	£3,000	0	0
1 „ „ ordinary shares	2,500	0	0

leaving a balance of £3,792 19s. 7d. to be carried forward to next half-year.

Official Announcements re Companies.

Unless cause is shown to the contrary the following are to be struck off the register within three months:—

Association for the Protection of Telephone Subscribers, Ltd.
Aurora Electric Lighting and Distribution Co., Ltd.
Bournemouth, Poole and District Light Railways (Electric) Co., Ltd.
Dowson Economic Gas Co.
Dynamometer Syndicate, Ltd.
East Grinstead Electric Lighting Co., Ltd.
Electrical Purification Association, Ltd.
Electric Cycle Syndicate, Ltd.
Electric Railway Omnibus Co., Ltd.
Electrograph Syndicate, Ltd.
Finchley District Electric Traction Co., Ltd.
Hermite International Electrical Sanitation Co., Ltd.
I.E.S. Accumulator Co.
Improved Patent Forced Draught Furnace Syndicate, Ltd.
Kilduchevsky Mega-Telephone Syndicate, Ltd.
Madrid Street Tramway Co., Ltd.
Nalder & Harrison Construction Syndicate.
New Mayne Electric Rudder-Motor Syndicate.
Portable Electric Lamp Co., Ltd.
St. Martin's Electrical Manufacturing Co.
Telephone and Switchboard Syndicate, Ltd.
Tyneside Electric Power Co., Ltd.
Western Countries Electric Railways and Tramways Co., Ltd.
Weymersch Electric Battery Syndicate, Ltd.

The following have been struck off the register:—

Great Oceanic Telegraph Co.
Scilly Island Telegraph Co.
United Kingdom Electric Telegraph Co.

County of London and Brush Provincial Electric Lighting Company.

The directors have declared an interim dividend on the preference shares at the rate of 6 per cent. per annum for the half-year ended June 30th, 1902, and an interim dividend on the ordinary shares

for the same period at the rate of 4 per cent. per annum. The amount of electricity sold in the company's London districts during the half-year is estimated to realise £43,985, which compares with £39,693 for the corresponding period of last year.

Anglo-American Telegraph Company.

The directors' report, to be submitted at the half-yearly meeting at Winchester House to-day, reads:—

The total receipts from January 1st to June 30th, 1902, including the balance of £1,955 2s. 2d. brought forward from the last account, amounted to £169,908 4s. 6d. The traffic receipts show a decrease of £13,167 as compared with the half-year ended June 30th, 1901. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £58,930 12s. 4d., being a decrease of £6,048 10s. 8d. as compared with the corresponding period of 1901. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £98,977 12s. 2d. One quarterly interim dividend of 12s. 6d. per cent. on the ordinary stock, and of £1 5s. per cent. on the preferred stock, was paid on May 1st, 1902, absorbing £43,750, and a second quarterly dividend of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on August 1st, 1902. The balance of £2,727 12s. 2d. will be carried forward to the next account. All the main cables and land lines of the company are in good working order.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to Colombo Electric Tramways and Lighting Company, Limited, 5 per cent. first mortgage debenture stock; and to allow the following securities to be quoted in the Official List:—Urban Electric Supply Company, Limited, 30,000 5 per cent. cumulative preference shares of £5 each, £3 paid, Nos. 50,001 to 80,000, and 30,000 ordinary shares of £5 each, £3 paid, Nos. 8 to 30,007 (renewed application). The Committee has further appointed a special settling day as under:—Thursday, August 7th, British Westinghouse Electric and Manufacturing Company, Limited, £500,000 4 per cent. mortgage debenture stock. The Committee has also ordered the undermentioned securities to be quoted in the Official List:—British Insulated Wire Company, Limited, further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 70,001 to 80,000. British Westinghouse Electric and Manufacturing Company, Limited, £500,000 4 per cent. mortgage debenture stock. Callender's Cable and Construction Company, Limited, further issue of 5,000 ordinary shares of £5 each, fully paid, Nos. 40,001 to 45,000. Edmundson's Electricity Corporation, Limited, further issue of 10,000 ordinary shares of £5 each, fully paid, Nos. 40,001 to 50,000; and 4,500 ordinary shares of £5 each, fully paid, Nos. 35,501 to 40,000. Notting Hill Electric Lighting Company, Limited, £50,000 4 per cent. first mortgage debentures of £100 each, Nos. 1 to 500 (registered).

Prospectuses.—Subscriptions have this week been invited by Callender's Cable & Construction Company, Limited, to an issue at 105 per cent. of £110,000 4½ per cent. debenture stock.

It is stated that the National Electric Traction Company, Limited, has posted the first batch of letters of allotment in the City and Surrey Electric Railway.

Metropolitan Electric Supply Company.—The directors have declared an interim dividend for the half-year ended June 30th last of 7 per cent. per annum, being an increase of 1 per cent. upon the interim dividend paid for the same time last year.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.	Total to date. Am'nt.	Inc. or dec.	Miles open. This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	July 25	885	+178	14,747	+ 2,738	—	—
Blackpool and Fleetwood	,, 26	1,209	+171	3,559	— 672	—	—
Bristol Trys. & Car. Co.	,, 25	4,720	+ 45	—	—	—	—
British Elec. Trac. Co.:—							
Devonport	,, 18	511	+ 40	11,822	+ 863	—	—
Dudley—Stourbridge..	,, 18	898	+189	20,271	+ 2,869	—	—
Gateshead	,, 18	836	+213	19,958	+ 2,859	—	—
Greenock—Pt. Glasgow	,, 18	507	+242	13,225	+ 7,695	—	—
Hartlepool	,, 18	333	+ 27	6,761	+ 742	—	—
Kidderminster	,, 18	163	— 18	3,297	+ 34	—	—
Merthyr	,, 18	214	— 37	5,752	— 752	—	—
Middleton	,, 18	398	—	5,191	—	—	—
Oldham—Ashton ..	,, 18	604	+ 57	14,577	+ 507	—	—
Poole	,, 18	322	— 9	6,658	— 99	—	—
Potteries	,, 18	1,488	+ 19	41,014	+ 1,554	—	—
Southport	,, 18	358	+139	6,478	+ 2,221	—	—
South Staffordshire..	,, 18	829	— 16	21,937	+ 684	—	—
Swansea	,, 18	527	+ 8	13,015	+ 1,424	—	—
Taunton	,, 18	83	—	1,728	—	—	—
Tynemouth	,, 18	456	+ 53	7,239	+ 618	—	—
Wolverhampton Dist.	,, 18	277	+214	4,283	+ 2,702	—	—
Weston-super-Mare..	,, 16	260	—	1,996	—	—	—
Central London Railway	,, 26	6,218	+269	26,591	+ 2,198	6	6
City and S. London Ry.	,, 27	2,715	+209	10,801	+ 3,341	6½	4½
Dover Corporation Trys.	,, 26	227	— 13	6,107	+ 174	3	3
Dublin United Trys. ..	,, 25	5,196	+ 66	13,466	— 409	46	46
East Ham Tramways ..	,, 26	451	+ 99	—	—	5½	—
Glasgow Corp. Trys. ..	,, 26	9,963	—3,196	26,606	— 900	55½	44½
Liverpool Overhead Ry.	,, 27	1,551	— 47	6,279	— 538	6½	6½
Newcastle Corp. Trys. ..	,, 26	2,864	—	—	—	—	—
Sunderland Corp. Trys.	—	—	—	—	—	—	—

STOCKS AND SHARES.

Wednesday Evening.

General business on the Stock Exchange continues in a limp condition, and markets on the whole show only a very small improvement over last week. The many sinister rumours that have been circulated concerning the King's health, have had their effect on markets, but they are difficult to believe in view of the excellent bulletins now being issued. Home Rails have been an irregular market, despite the fact that the dividends announced so far have been well up to expectations. The weak spot in this section is the rumoured issue of new stock by several of the companies. Underground Railways keep steady, and a rise of 1 per cent. is noted in Central London 4 per cent. Preferred stock. The motor car (multiple unit) system that has been determined upon by the directors, as a means of solving the vibration question, is expected to be in working order by the end of the year.

The electrical division remains steady, and our list of prices has scarcely an alteration to show. Brompton issues have risen ¼ to 9¼—9⅜, and a fair amount of business has been passing in them. Charing Cross do not move, and at 9—10 are firm. The Preference show no change in the quotation figure, but dealings were registered at 5½—⅝. Chelseas at 5½—⅝ exhibit no alteration, whilst the Debenture at 109—112 was inquired for. Citys are 9, with no trade passing. The half-yearly report issued by the City Company is rather interesting, as it shows to what extent the competition is affecting them. The increase in the number of customers is only 32, whilst lamps connected are 9,351 more than on January 1st. Although this shows a considerable falling away, as compared with previous half-years, it would appear that each new customer had been connected to the extent of upwards of 280 8-c.p. lamps. This anomaly probably is accounted for by the loss of many small customers and the addition of larger consumers. The gross revenue is lower by £1,892, but largely owing to lower cost of coal. The net revenue is better by nearly £10,000, or 20 per cent. better, which may be considered satisfactory.

Countys are the turn harder at 8¼—9 on the announcement of the interim dividend at the rate of 4 per cent. per annum. Edmundson's Ordinary and Preference have been quietly bought by investors, and the Debenture has also received attention. London Ordinary and Preference have been dealt in and close unchanged on the week. The interim dividend of 7 per cent. in Metropolitans is 1 per cent. better than last year, and the price closes hard at 16—16½. Notting Hills are stationary at 13½—14½. An official quotation has been granted for the 4 per cent. First Mortgage Debentures of this concern. The amount of stock issued is only £50,000, and up to the present we have never heard of any dealings in it. Westminsters are unchanged on the interim dividend at the rate of 11 per cent.

Like the rest of our list, industrial and traction companies show very few alterations. In British Electric Traction issues no variations have to be recorded, but a good business has been doing in them. British Insulated Wire Ordinary have shed ½ and the Preference are ¼ lower at 5½—⅝. We hear there was a big rush for the new issue of Callender Cable 4½ per cent. Debenture, and many applicants are likely to be disappointed with their allotments. The issue was of £110,000 at 105 per cent., and is redeemable at any time after 1916 at 110 on six months' notice. The net profit for 1901 was £71,980, which is enough to pay the debenture interest seven or eight times over. Edisons do not move, and Electric Constructions maintain their price of last week. The rest of the list keeps steady, the only alteration being an advance of 1 per cent. in Telegraph Constructions to 36—39.

In the Telegraph department several of the stocks and shares are quoted *ex* dividend, but the changes in prices are but slight, reflecting the amount deducted in the majority of cases. It would be tedious to mention each concern in the list separately, as nothing of interest has occurred. The whole position may be summed up by saying that very little has been doing, and consequently prices have not changed since last week.

The Swansea Improvements and Tramways issue of 4½ per cent. Debenture is a fair investment of its class, but as the issue is only of £26,250, there can, of course, never be anything of a market in it.

Glasgow Telephones.—It is stated that the Corporation, with an annual revenue of £38,000 from its telephones, has made a profit of £434 on the year's working of the enterprise. The expenditure on the system has been £199,000.

Meetings.—Owing to pressure upon our space, several reports of electrical and telegraph companies have had to be held over until next week.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations July 23rd.	Closing Quotation July 30th.	Business done during week ended July 30th, 1902. Highest.	Lowest
£2,300	African Direct Telegraph, 4 % Debs	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
304,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	46 — 49	45 — 48 xd	...	...
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	90 — 92	89 — 91 xd	91½	89⅝
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	6½— 7	6½— 7	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5%	3⅝— 4½	3⅝— 4 xd	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96⅛	95⅝
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
5,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	12½— 13½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	7⅞— 8⅛	7⅞— 8⅛	...	...
60,710£	Direct United States Cable	20	3¼%	3¼%	3¼%	10 — 11	10 — 11	10⅜	10⅛
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	120 —130	117 —127	125	119
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	87 — 90	87 — 90	87⅜	87
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —112	108 —112	110⅛	108⅜
800,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	12 — 13	12 — 13	12 5/16	12
820,000£	Do. 4 % Deb. Stock	Stock	...	...	...	109 —114	108 —113	111½	110
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	8½— 9½	8½— 9½	9⅜	9¼
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	13⅛	13
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	25 — 27	25 — 27	25⅝	...
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41	37 — 41	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	101 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	97½	97
200,000	Do Pref. shares	2	...	3⅛	3⅜	4⅝— 4⅞	4⅝— 4⅞	4⅛	...
1,966,667	Do Def. Stock	100	...	60	64 xd	56 — 60	56 — 60	58½	56½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 97	95 — 98	96⅛	95⅝
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	6½— 7½	6⅝	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4⅜— 5¼	4⅜— 5¼	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	4 1/16	4⅞
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	101 —104	...	...
165,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	97 —100	97 —100	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11½— 12½	11 1/16	...
75,000£	Do do. 5 % Debs. 2nd series, 1926 ...	100	...	...	...	101 —104	101 —104	...	...
848,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	98 —101	97 —100	99⅜	...
88,321	West India and Panama Telegraph	10	5%	...	...	¼— ½	¼— ½	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	4⅜— 5¼	4⅜— 5¼	5¼	4⅞
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 4	3 — 4	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	...	...	...	99 —102	97 —100	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	103 —106	103 —106	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	9¼— 9⅝	9½	9 7/16
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9½	9¼— 9⅝	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	...	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5¼— 5⅝	5¼— 5⅝	...	...
150,000£	Do do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	8½— 9½	8½— 9½	9	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	109 —112	109 —112	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6 — 6½	6 — 6½	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6½	6½
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11 xd	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 4½	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	94 — 99	94 — 99	95½	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	15½— 16½	15½— 16½	16	15⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	109 —113	108 —112	109	...
250,000£	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13½— 14½	13½ - 14½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½—15½ xd	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½ xd	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord. ...	5	...	...	...	1⅞— 2⅛	1⅞— 2⅛	...	...
50,000£	Do. do. 4 % Deb ...	100	...	...	...	80 — 90	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord ...	5	...	...	...	2½ — 3	2½ - 3	...	...
109,518	Westminster Electric Supply, Ord. ...	5	12 %	10½ %	10½%	10½ 11½	10½ 11½xd	11⅜	10⅞

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year, consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotation July 23rd.	Closing Quotation July 30th.	Business done week ended July 30th, 1902.	
		‡	1899.	1900.	1901.			Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	4 — 5	4 — 5	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	83 — 86	83 — 88	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	12¼— 13½	12½— 13½	13	12½
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½— 12⅝	12½— 12⅝	12⅝	12⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	126	124½
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½— 8½	7½— 7⅝	...	...
70,000	Do. do. 6 % Cum. Pref	5	...	...	...	5½— 6	5½— 5⅝	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ . 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½%	5 %	Nil	1½— 1⅝	1½— 1⅝	...	...
150,000	Do. do Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1½— 2	1½— 2	...	...
125,000£	Do do 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	94 — 99	95 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	15½— 16½	15½— 16½	...	...
40,000	Do do 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	105 — 108	105 —108	107	106
440,100	Do do. 4 % Pref. Stock	Stock	...	...	4 %	107 — 110	106 —109	107½	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	103 —106	103 —106	104⅝	104½
855,000	City and South London Railway	Stock	1⅞%	1½%	2 %	72 — 74	71 — 73 xd	73	72
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	2⅝— 3½	2⅝ — 3½	...	...
100,000£	Do 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —106 %	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do do "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½ — 2½	1½ — 2½	...	...
344,023£	Do do do. 4 % Deb. Stock Red ...	100	...	...	...	76 — 78	74 — 78	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	76 — 81	82 — 86	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 2 xd	1½— 2	...	...
31,390	Do do 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3 xd	2½— 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —100 xd	97 —100	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜— 10½	9⅜—10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 — 101	99 —102	...	...
35,000	Henley's (W T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16⅞	...
35,000	Do. do do 4½ % Pref.	5	4½%	4½%	...	5⅛— 5⅜	5⅛— 5⅜	...	...
50,000£	Do. do do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	21 1/16	20⅝
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 — 103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅜%	3¼%	1½%	4 1/16— 4 1/16	4⅛— 4⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10½— 11	10 — 10½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	14½—15½ xd	14½— 15½	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ..	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	35 — 38 xd	36 — 39	38	37⅜
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	92 — 95	95½	...

* Quotations on Liverpool Stock Exchange ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—5/16.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, July 30th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	£38 10	..
a „ „ ..	per ton	£32	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£19	£19	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (76/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£8	£8	..
a Shellac	per cwt.	106/-	106/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£8 5	£8 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£9	£9	..
a Bichromate, casks	per lb.	9½d.	9½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£140	£140	..
b „ Wire, in ton lots	per ton	£130	£130	..
b „ Sheet, in ton lots	per ton	£190	£190	..
p Babbitt's metal ingots.. ..	per ton	£40 to £140	£40 to £140	..
c Brass (rolled metal 2 to 12 basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) ..	per lb.	7d.	7d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
g Copper Sheets	per ton	£69	£69	..
g „ Rod	per ton	£69	£69	..
c „ Electrolytic) Bars ..	per ton	£68	£68	..
c „ „ Sheets ..	per ton	£75	£75	..
c „ „ Rod ..	per ton	£68	£68	..
c „ „ H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheets	per lb.	5/-	5/-	..
a German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	2/11½ to 3/-	2/11 to 2/11½	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	51/1	50/3	10d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 5 to £11 7 6	£11 5 to £11 7 6	..
g „ „ Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	5/8 to 7/8	5/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11¼d. to 1/3	11¼d. to 1/3	..
p „ rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
c Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£127 to £128	£127 to £128	..
g „ rod	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 10	per lb	1/7	1/7	..
p White Anti-friction Metals — "White Ant" brand	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/18s Grey Cotton, cop p'k	per lb	7d.	7d.	..
j „ 4 ply Flax	per lb	5½d.	5½d.	..
j „ 3 ply 10 lbs. Russian ..	per lb	4½d.	5½d.	..
j „ 10 lbs. Russian, single ..	per lb	4¼d.	4¼d.	..
j „ 180 lbs. Jute rope	per ton	£11 10	£11 10	..
k Zinc, sh's. (Vieille Montagne br'd.)	per ton	£23	£23	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs Bolling & Lowe. j Messrs Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

ELECTRIC BATHS FOR NORTH STAFFORDSHIRE INFIRMARY.

An interesting installation of apparatus for the treatment of lead poisoning and other affections has recently been laid down in the Potteries. The equipment provides for alternating and direct current electric baths, and has been carried out by Messrs. Marshall & Woods, Holborn, on lines suggested by Dr. Armstrong, of Buxton.

The necessary power is taken from the mains of the Potteries Electric Traction Company, which pass within about a quarter of a mile of the infirmary, to charge a battery consisting of 28 Chloride cells of 60 amp.-hrs. capacity, connected in series, the necessary resistance being obtained by means of five 5-light 16-c.p. fittings, which also serve to brilliantly illuminate the three rooms.

The battery is controlled by a two-way four-pole switch, which completely isolates it from the bath circuits while charging. From this switch leads are taken to a double-pole six-way connecting board, from which five circuits for continuous current baths may be taken.

Connected to the sixth pair of terminals is a ½-h.p. motor running at 3,000 r.p.m. and driving an 8-pole alternator wound to give 50 volts, 2 amps. The terminals of the latter are connected to a double-pole five-way connecting board, from which five circuits for alternating current baths may be taken.

Both the connecting boards are provided with copper clamps instead of fuses, to guard against a shock to the patient which would occur in the event of a sudden interruption of the bath circuit, fuses being inserted in the motor circuit only, where the momentum of the armature would be sufficient to prevent this.

Of the five bath circuits, one is for a large bath, two are for arm or foot-baths, and two for spare.

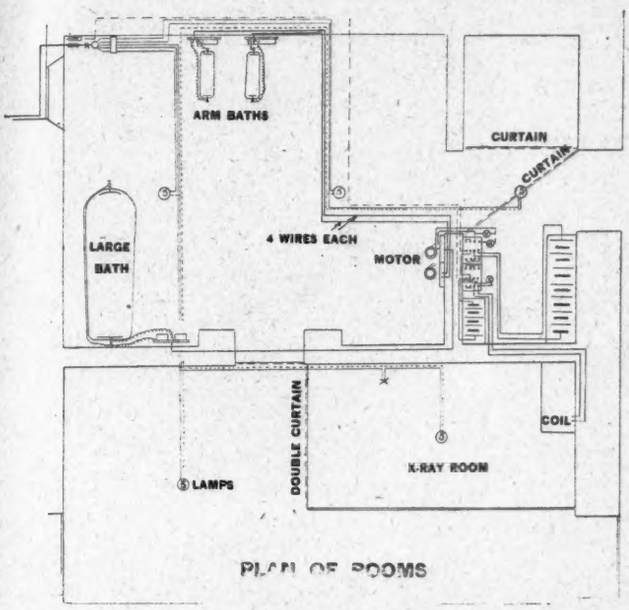
The arrangement of the controlling board for the large bath can be seen from the annexed diagram. The outer terminals of the double-pole two-way switch are connected to the first pair of terminals of the direct and alternating current connecting boards respectively; the centre terminals are connected through two 25-volt, 5-c.p. lamps to the ends of a resistance of about 250 ohms, the bath terminals being connected to the beginning of the rheostat, and to an arm which makes a sliding contact. This arrangement gives very gradual regulation, prevents any rush of current due to short circuits in the bath itself and minimises the effect of an accidental interruption of the bath circuit by loose contacts, &c.

The ammeter shown has a range of 0—300 milli-amperes and the voltmeter of 0—50 volts.

The efficiency of the alternating side is low, due principally to the high frequency required (200 periods per second), most of the power being absorbed in wind friction.

The controlling boards for the arm and foot baths are precisely similar to that for the large bath, but are without the ammeter and voltmeter; the bath electrodes are of the usual type, made of tin, framed in wood and provided with copper rods and binding screws. The baths are of porcelain.

A Röntgen ray apparatus has also been installed; a 10-in. coil supplied by Mr. Leslie Miller, of Hatton Garden, being worked from portable accumulators, which are charged through a four-pole two-way switch similar to the one already described.



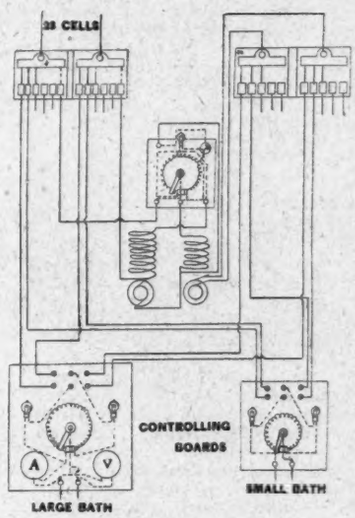
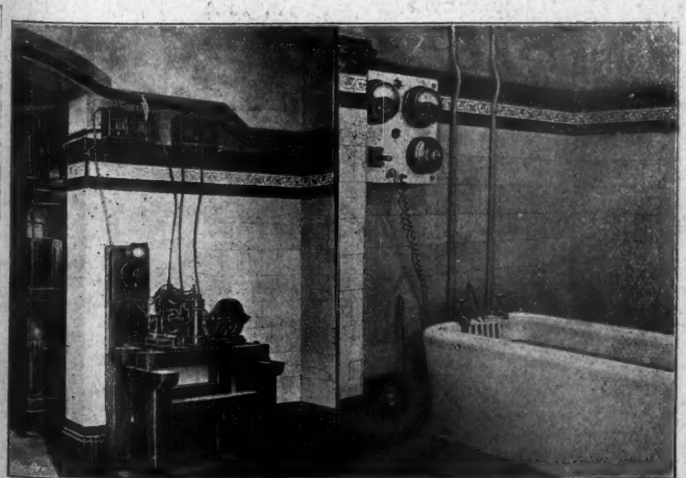
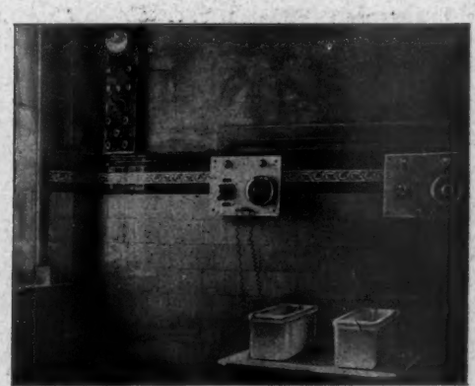


DIAGRAM OF CONNECTIONS

Electrical Rooms at North Staffordshire Infirmary.



Motor-generator and Battery Room.



Large Bath and Controlling Board.

Arm Baths and Main Switchboard.

A large part of the expense was borne by the Potteries Electric Traction Company, and Mr. Slade Olver, the former manager of the company, did all in his power to further the project. Mr. Walklate, the present manager, has also taken an active interest in the scheme, and one of his assistants, Mr. F. S Miller, supervised the execution of the work.

LIMITS AND LIMIT GAUGES.

Hitherto there has been no English manufacturer who has undertaken the commercial manufacture of limit gauges for machine shop work. Some few of American make have been sold in this country, but we believe very little effort has been employed to push the system of limit gauge working, and the American gauges were, we believe, rather coarse in their tolerances. So it was left to the Germans to push their limit gauges, and a very considerable business has been done in them, through the aid of English engineers, however, who understood the needs of English shops; to do them justice, the German gauges were well made, and usually accurate within commercial requirements. None the less we welcome a pamphlet by the Newall Engineering Company, of 36, Featherstone Street, London, E.C., which seems to show that at last an English firm has engaged in the manufacture of limit gauges. There are four usual "fits" in practical mechanics, namely:—

The force fit, which requires a screw, a hydraulic press, or the use of heat on one piece to get the fits together.

The drive fit, which can be done by a hammer.

The push fit, which can be pushed together by hand, and may even be revolved slowly, but would heat and seize if run for any time.

The running fit, which will run indefinitely if lubricated, and varies with the class of work. Running fits may be divided into several classes, and by Messrs. Newall, are classed in three divisions.

To suit all these fits there would be required as many limit gauges for one piece. All fits, of course, can be made to one limit gauge as regards the other piece.

Some people make all holes to one nominal size, and make the difference in the shaft.

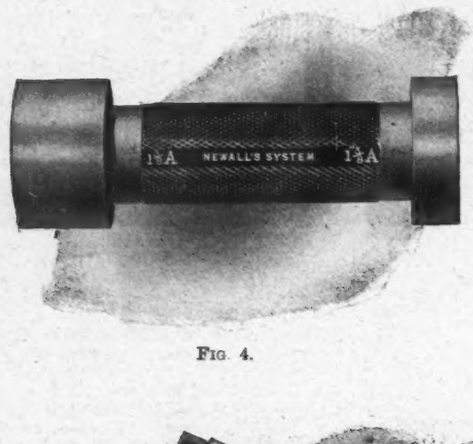


Fig. 4.

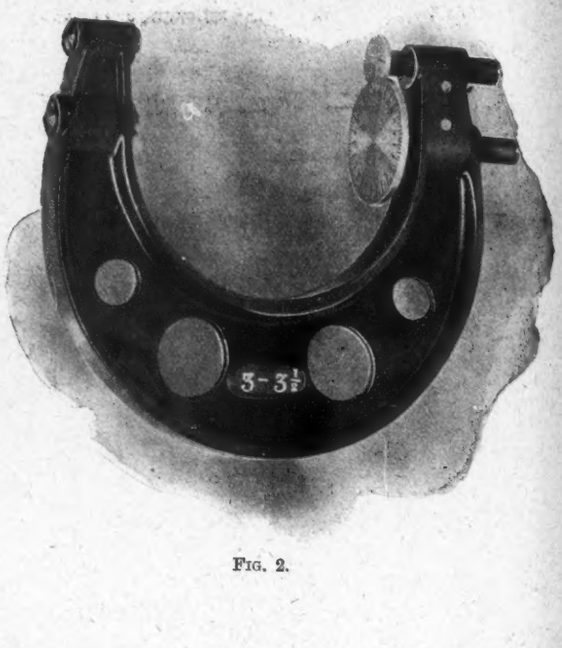


Fig. 2.

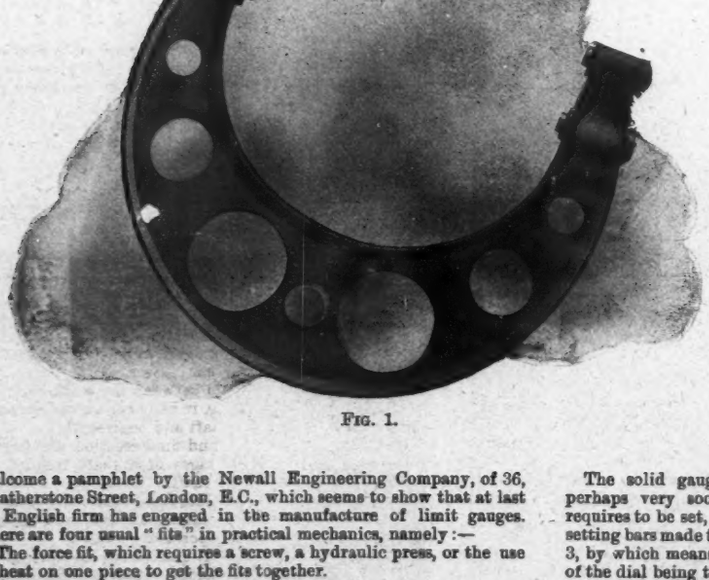


Fig. 1.

Fig. 3.

The British Admiralty make all shafts alike, and make the difference in the holes—probably because this is the more expensive way of going to work.

Even with the other system, so many fits, all calling for solid gauges, come very costly. Messrs Newall, therefore, make their limit gauges adjustable.

Their crescent-shaped calliper gauge herewith illustrated (fig. 1) is seen to have two anvil points and two screw points of hardened steel. A piece to be measured must pass through the outer points and refuse to enter between the inner points. It is then correct to size between the limits chosen. Thus, if the outer pegs were 0·001 in. further apart than the inner pegs, no measured piece could differ by so much as 0·001 from any other measured piece.

The solid gauge wears out in time, and must be replaced, perhaps very soon. The adjustable gauge lasts indefinitely. It requires to be set, and to do this the Newall Company supply either setting bars made to the desired limit, or a setting dial, as in figs. 2 and 3, by which means the gauge can be set to any limit, the graduation of the dial being to 0·00025, either directly or by vernier.

Thus if an engineer is already in possession of a set of standard plugs, he can buy an infinite series of limit gauges for £9 10s. that will measure for him from ½ in. to 6 in.

The company's measuring standards have been verified by the Board of Trade Standards Department, and all gauges are guaranteed to a close standard of accuracy.

The limits selected by Messrs. Newall have been derived from a careful study of general practice reduced to even curves.

Thus the gauge for holes of 1 in. diameter has one end 0·0005 in. over size and the other end 0·00025 in. under size, the limit or range being therefore 0·00075 in., or less than one-thousandth part of an inch, and as all work done by limit gauges is better than the gauges or less inaccurate than the nominal allowance, it is probable

that the widest variation between any two pieces would be under half a thousandth.

For the turned pieces to fit the holes thus made a mean of ·00175 in. above standard size is aimed at in the 1-in. size, the limits being ·002 in. and ·0015 in., and the margin ·0005 in.; the margin for a 6 in. shaft is ·002 in. Driving fits and running fits are similarly tabulated; we cannot here reprint the tables, but should advise those interested in shop work to secure a copy of the Newall Company's pamphlet.

With these limit gauges in the market there is now no excuse on the score of expense for refusing to work to the limit-gauge system.

We are sure that much good work is done by means of standard gauges and thin paper for giving differences. Such a system, however, cannot be recommended, for it is costly to carry out—costly, that is, in labour. It is a system more suited to the mechanician's laboratory than to the workshop, and though perhaps justifiable in face of the heavy cost of a full set of limit gauges, it is not worthy of adoption where adjustable limit gauges can be procured.

Newall's internal limit gauge is shown in fig. 4.

ELECTRICITY FOR MOTIVE POWER.

We have often had occasion to refer to the remarkable extent to which the single-phase motor is disused, so to speak, in this country, compared with its wide adoption abroad. There appears to be a general distrust of it among central station engineers and their clients, or perhaps the former are over-solicitous with regard to the inscription of a dead straight line upon the charts of their recording voltmeters. Whatever the cause, the fact remains that in the great majority of our power stations supplying single-phase current only, the motor load is utterly insignificant.

The following figures, taken from our "Electricity Supply Works" list for 1902, will serve to illustrate this fact, it being observed that stations having a motor load of less than 100 H.P. are omitted:—

Station.	Frequency.	Kilowatts installed.	Motor load, H.P.	Price.
Derby ...	40	2,300	500	3d. & 1d.
Harrogate ...	50	1,150	120	2½d.
Huddersfield ...	100	2,290	236	2½d. & 1d.
Leicester ...	50	1,400	192	2d.
Portsmouth ...	50	2,560	132	2½d.
Redditch ...	66	350	100	2d. to 1d.
West Ham ...	50	3,100	133	5d. & 1d.

It will be noticed that one of the most fortunate stations in respect of a motor load is Huddersfield, with a frequency of 100 periods per second; Redditch, too, has a remarkably good showing, in comparison with the kilowatts installed. It is evident, therefore, that high frequency alone is not responsible for the poor results elsewhere. Moreover, even where a frequency of 50 periods per second is in use, and the district is exceptionally calculated to call for motive power, as at Leicester, but a poor apparent demand is obtained.

On the other hand, the motor load on the Derby supply system stands out far in advance of the rest, with 500 H.P. of motors—say, 500 KW. at the main switchboard—against 2,300 KW. of generators. How has this healthy state of things been brought about?

What can be done at Derby can equally be done elsewhere, under corresponding conditions. It may be said that some station engineers are not desirous of a large motor load, on account of the possibility of fluctuation being caused in the voltage on their distributors; but this certainly cannot be said of all. Moreover, it is, we are convinced, a short-sighted policy to pursue. The motors would be used mainly in the daytime, when a slight fluctuation of voltage is quite immaterial; the plant is of little use in daylight except for the supply of motive power, which at the same time confers a marked benefit upon the community, and is of a very profitable nature to the supply authority. Where motors are installed of a size sufficient to seriously affect the voltage, the use of starting devices which obviate the necessity of a heavy out-of-phase current being taken can be insisted upon; and it should not be forgotten that the same difficulty is met with, though to a less extent, on direct current systems, but has not led to the throttling of the power demand in the case of the latter. Far too much is made of the starting difficulty, which is largely chimerical, and can always be overcome when it exists. There is even less objection to synchronous single-phase motors in the case of really large units, and these possess certain advantages which fully compensate for their drawbacks; their speed is as constant as that of the generators; they will bear a large overload if called upon to do so; their excitation can be adjusted to give a power factor not far from unity, and they are exceedingly simple machines.

We do not for a moment advocate the adoption of single-phase supply in preference to direct or polyphase currents, but we strongly urge the engineers of existing single-phase systems to see what can be done in their districts with single-phase motors before they plunge into the expense of conversion to another system. A motor demand *must* be developed by every station, or its days are numbered, for the public will not be content to forego the supply of motive power and to pay 4½d. to 6d. per unit for lighting purposes, when the large power distribution companies get to work and offer energy for lighting at 3d., and for power at 1d., just outside the area of supply. It will be purely a matter of business, and unless the small station can beat the large one in both price and quality, it must go.

The following particulars relating to the motor load in Derby may be of use to engineers, as showing the conditions under which the remarkable success in this department has been attained; the data are more recent than those quoted above, and, we are pleased to add, still more encouraging. Perhaps the same would be true of the other single-phase stations; at any rate, we hope so.

The supply at Derby is single-phase alternating current, at 100 and 200 volts, 40 periods per second. The sale of energy during the past four years has been as follows:—

Year ending	Units sold. Total.	Units sold for power.	Per cent units for power.
March, 1899 ...	469,568 ...	18,092 ...	4
„ 1900 ...	617,414 ...	49,600 ...	7⅞
„ 1901 ...	754,952 ...	73,882 ...	9⅞
„ 1902 ...	(1,063,233) ...	186,347 ...	17½

Sizes and Number of Motors.

Consumers' own motors. No.	Size.	Total.	Motors hired from Corporation (April 30th, 1902.) No.	Size.	Total.
1	¼-H.P. ...	¼ H.P.	11	¼-H.P. ...	5½ H.P.
9	½ „ ...	4½ „	16	1 „ ...	16 „
9	1 „	9 „	24	2 „ ...	48 „
2	2 „ ...	4 „	1	3 „ ...	3 „
2	3 „ ...	6 „	27	4 „ ...	108 „
5	4 „ ...	20 „	15	6 „ ...	90 „
2	5 „ ...	10 „	8	9 „ ...	72 „
7	6 „ ...	42 „	9	12 „ ...	108 „
1	9 „ ...	9 „	1	15 „ ...	15 „
1	32 „ ...	32 „	1	25 „ ...	25 „
1	12 „ ...	12 „	1	35 „ ...	35 „
1	25 „ ...	25 „			
41 motors.		173⅝ H.P.	114 motors.		525½ H.P.

The total number of motors is therefore 155, with a rated power of about 700-H.P. Of these, about 130 are Langdon-Davies motors.

The charges for electrical energy for the purpose of motors and cooking and heating, supplied through separate meters, are 3d. per unit for the first average 12 hours' consumption per week of the maximum demand, 2d. per unit for the next period of 18 hours, and 1d. per unit above this quantity.

When the consumer guarantees the use of his motor for 50 hours per week at the maximum demand, the charge is a fixed rate of 1½d. per unit.

Rates of Hire of Motors.

B.H.P.	High speed type. Rent per quarter. £ s. d.	Low speed type. Rent per quarter. £ s. d.
½	10 0	13 9
1	13 9	18 9
2	18 9	1 5 0
4	1 8 0	1 12 6
6	2 1 9	2 5 0
9	—	2 17 6
12	—	3 10 0

The Corporation have made arrangements whereby motors let out on hire are insured against external fire, and the rents given above include this provision. The rents also include an ammeter and minimum cut-out in the case of all motors above 4 B.H.P.

SOME DETAILS OF DIRECT-CONNECTED GENERATOR SETS.*

By WILLIAM H. BRYAN, St. Louis, Mo.

1. The results of a recent investigation into some details of the design and construction of steam-driven direct-connected generators may be of interest. The inquiry covered:—

First. The procedure usually followed between the builder of the generator and the builder of the engine, in reaching an understanding regarding the detailed design of shaft and bearings.

Second. The method of construction and final erection preferred.

Third. The advantages and disadvantages of a shaft coupled by flanges, as compared with a continuous shaft.

Correspondence regarding these points was conducted with a number of the leading engine and generator builders, and was supplemented by personal interviews as opportunity offered.

2. There seemed to be a practically unanimous agreement to follow the general design and dimensions recommended by the Society's Committee on Standardisation of Engines and Dynamos, in its final report at the New York meeting, December, 1901†. Pending the adoption of these rules, however, or where for any reason the case seems to demand special consideration, the following procedure is usually followed:—

On receipt of the order at the works of the generator builder, a certified dimension print is prepared, giving the data which the engine man needs to design his shaft. This drawing shows:—

A. The limit lines beyond which the engine parts must not extend.

* Paper read at the Boston meeting (May, 1902) of the American Society of Mechanical Engineers.

† Electrical Review, Vol. 50, p. 155.

B. The form which the shaft should have within the armature spider.

C. The weights of revolving parts.

D. The unbalanced magnetic pull for $\frac{1}{16}$-in. displacement, which might result from the armature getting a little out of centre, by the wearing of bearings or otherwise.

Usually the diameter of the shaft is left wholly to the engine builder, after putting him in possession of the data necessary to design the same intelligently. The custom is now almost universal of supporting the brush holder rigging on the generator frame, so that the engine builder is relieved of any responsibility on that account. As a rule, also, the engine builder furnishes the extended base, outboard bearing, holding-down bolts, and shaft keys.

3. The unbalanced magnetic pull (paragraph *D* above) is of decided importance, and its possible effect must not be overlooked. This pull may, of course, be in any direction in the plane of revolution, and it varies as the square of the displacement. It must be considered in determining shaft dimensions and bearings, as it may occur in a vertical plane, and thus have the same effect as additional weight of armature. It may also occur in a horizontal plane, and must, therefore, be considered in designing the bedplate and foundation bolts.

Usually the generator builder makes his armature hub sufficiently thick to provide for considerable variation in the diameter of the shaft, as may be required by different engine builders. If, for any reason, the generator builder has already fixed the bore of the armature, the engine builder is expected to meet that condition. If he cannot readily do so, the matter is one which must be taken up further for adjustment, or settled by the purchaser or his engineer.

4. On receipt of the above data, the engine builder is supposed to proceed at once with the design of a shaft suitable for the intended work. When completed, his drawings are forwarded to the generator contractor for checking and approval. On receipt of approved drawings the engine builder proceeds with the construction of the shaft.

As soon as possible after receipt of the shaft dimensions from the engine builder, the contractor for the generator prepares a pin gauge giving the exact dimensions of the bore of the armature hub. There is a general acquiescence in the recommendation of the Society's Committee that the engine builder make the necessary allowance for the press fit. A few builders, however, advise that the generator contractor provide the allowance when making the gauge, so that it will show the actual diameter to which the finished shaft is to be turned. In justification of this position they claim that the allowance depends far more on the material of the armature and the design of the hub than it does on the shaft. In most cases the allowances recommended by the Society's Committee for shrink fit are considered ample, although one prominent generator builder thinks the allowance should be doubled.

5. Sometimes there is a departure from the above plan of procedure to the extent that the one whose work is furthest advanced makes the pin gauge, and sends it to the other, who governs himself accordingly.

Although all generator builders claim, in advance of award of the contract, that they are prepared to furnish generator data to the engine builder almost immediately on receipt of order, there is almost invariably a serious delay in reaching an agreement between the two contractors. This loss of time is sometimes due to the necessary "red tape" through which an order must pass before it reaches the construction department. Sometimes it is claimed to be due to delays in the mails. Sometimes the data are withheld pending the execution of the formal contract by the proper officials. These delays are often serious when the work is of the "rush" order, and it seems that an effort in good faith should be made to avoid them. Is there any good reason why full data on standard machines—even including shaft gauges—should not be kept on hand at the district offices for immediate delivery to the engine builder on award of contract? It has even been suggested that bidders on generators be required to file with their proposals the necessary shaft data. This would save much vexatious delay. It is, of course, presumed that the speed of rotation has been decided upon and agreed to by both parties when the contracts are closed.

6. When the engine contractor returns his drawings of shaft to the generator builder the following information is supposed to be given:—

E. Direction of rotation—whether clockwise or opposite—when looking at the commutator end of the machine.

F. Location of generator with reference to engine, whether commutator is on the right or left of generator when standing at cylinder and facing shaft.

G. Further details, such as whether there are one or more cranks, whether they are solid forged or forced on, height of centre of shaft above floor, diameter of shaft, location of armature and fly-wheel in relation to bearings, dimensions and weight of fly-wheel, length of hub and cross-section of rim.

Some difference of opinion exists as to the best method and place of erecting the armature on the engine shaft. The ordinary practice for small and medium sized units is for the engine contractor to place the shaft in final position where the unit is to be used, after which the generator contractor presses on the armature, and completes the adjustment of the electrical machine ready for service. This necessarily involves some extra expense when the point of erection is at some distance from the builders' shops, or where they have no local erecting gang. Furthermore, the work is always more expensive, and can never be as satisfactorily or as quickly done, as in the shops of one or the other of the builders. There is a widespread sentiment, therefore, that either the generator contractor should send his armature to the engine shops where it can be placed on the shaft by the engine builder, or that the shaft itself—in whole or in part—be shipped to the generator builder for the armature to be pressed on, the latter arrangement seeming the preferable one. This plan possesses many advantages, but is open to the criticism that extra freight charges are incurred and delays invited.

7. The relative location of the two shops with reference to the point of final use would seem to be a factor in determining which shop should press the armature on. For a set destined for erection in St. Louis, for instance, the engines being built at Springfield, Ill., and the generators at Schenectady, N.Y., it would not be justifiable to ship the engine shaft to Schenectady and return. The fact that as soon as the armature is attached to the shaft the whole becomes electrical apparatus, and takes a higher freight classification, has a bearing on the subject; also that there is an increased freight cost in dividing shipments instead of concentrating them. The contracts should state definitely who is to pay the increased freight charges.

Trouble often results from the erection of the armature on the engine shaft at a distance from the shop, where competent men and suitable facilities are not always to be had. This is particularly the case with centre-crank engines, where the crank pin may be sprung, unles a piece is fitted between the jaws of the crank before the pressure is put on.

8. Several prominent builders recommend mounting the armatures on conical collars instead of the usual press fit. This is claimed to lessen the time of erection, obviate the chances of springing the shaft, and remove all danger of misfit. Furthermore, if the owner ever desires to remove the armature, it becomes a simple and inexpensive matter. On the other hand, it is claimed by many large builders that the press fit is more rigid, distributes the strains better, is less expensive, and, everything considered, is superior.

9. For many years I have specified that the engine shaft carrying the armature should be continuous, and not coupled by flanges or otherwise. This arrangement seemed to have the approval of the best engineers and builders on account of its superior rigidity and reliability, as well as the space required on the shaft. It is still preferred by most of the largest generator builders, although many of them do not object particularly to the coupled construction. Sometimes the use of the solid construction involves delay in getting the necessary forgings, as well as extra cost, if it is a rush order. Ordinarily, however, the coupled construction is the more expensive one, but some time may be saved by its use. I was surprised to find a large and growing sentiment among builders of centre crank engines in favour of the coupled form of shaft, the argument being substantially as follows:—

10. The armature shaft being a short and simple structure could readily be sent to the generator shops for the armature to be pressed on, freight and boxing both being less. Time could always be saved, as it would only be necessary to fit the shaft, adjust it centrally in the outer bearing, then box and ship it, the main shaft being retained to complete the work of balancing, polishing, &c. There will be no danger of springing the shaft, as explained above. Earlier delivery of the complete engine could usually be made, as the engine shafts could be made in quantities, and kept in stock. When time is short the engine builder could complete all his work, except the extended shaft, whereas there is often a delay if a continuous steel forging is necessary. The entire engine can be completed—and even tested—while waiting for the forging for the armature shaft, which on arrival can be finished up in a few days. Some builders are preparing to make up a stock of crank shafts with flanges finished solid on the end of the shaft ready to receive the flanged armature shaft, which will be specially constructed in each case to fit the generator selected. The saving in time and expense is obvious.

I have not been able to satisfy myself, however, that a coupled shaft is as desirable, everything considered, as the solid one, as the chances for inaccuracy and derangement appear greater. The increased space required is also often important, particularly in city plants. There is room for argument on this point, however, and the hope for a full discussion is my principal incentive for presenting this paper.

11. Is the overload limit of 25 per cent. recommended by the Committee wise? Most generator builders now guarantee their standard machines to safely carry 50 per cent. overload for one hour or longer. Should not the engine have a similar margin? Often the peak of the load lasts but an hour or so, and it is better engineering to run at reduced efficiency for this short period, rather than to invest a greater amount in a unit which will be underloaded for the rest of the 24 hours. This can be accomplished by a later cut-off, if the engine is structurally strong enough. Part might also be gained by running up the steam pressure a little, but this is not always permissible.

It is to be hoped that engine and generator builders will promptly carry out their agreement as to early compliance with the details established by the Society's Committee on Standardisation, and that there will result great shortening in the time now necessary to agree on shaft data. May the day speedily come, also, when a similar agreement may be reached as to standard sizes of alternating and railway generators.

Liverpool.—The B. of T. has directed Mr. A. P. Trotter to consult with various electrical and civil engineers in view of the proposed revision of regulations affecting the electric lighting and tramways of the Corporation.

GAS POWER STATISTICS.

At the recent Tramways Congress, figures were presented by M. Thonet, of Liège, on various subjects, including gas engines and producers.

At Barcelona, where Crossley engines are at work, there are two of 165 H.P. and one of 300 H.P. running at 180 r.p.m., and using gas from a rotating hearth producer of the Fichet and Heurtey system. Steam is supposed to be employed in the producer, and we presume that the gas analysis below was taken from steam-produced gas and not from a producer worked with an air blast, said to have been put in place of steam, for, as will be seen, there is too large a percentage of hydrogen. The gas analyses to:—

Nitrogen	50	per cent.
Hydrogen	20	,,
Carbonic oxide	20	,,
Carbonic acid	5 to 7	,,
Hydrocarbons	2 to 3	,,

with a calorific power of 1,200 to 1,300 calories per meter cube, or 135 to 146 B.Th.U. per cubic foot.

The gas, as produced, is cooled in a regenerator, which warms the air blast. It then passes through a coke scrubber and through filters of sawdust and of iron oxide, which is regenerated by exposure to the atmosphere every month. The average cost of maintaining gas engines and producers averages 0·025 to 0·06d. per KW.-hour, and is to be estimated at 0·05d. per KW.-hour as a fair covering value.

The coal consumption of producer gas engines has been found as follows:—

	At guarantee tests.	Under ordinary working.
Per eff. H.P.	1·32 lbs.	1·485 lbs.
,, car kilometre ...	—	1·98 ,,
,, KW.-hour	—	2·2 ,,
,, car-mile	—	3·19 ,,

Coal in 1900 cost 62 pesetas, or about 37s. 6d. per ton, but is now only about 29s.

In 1901 the consumption per car kilometre reached 0·9 units, or, say, 1·45 units per car-mile. At present the consumption of screened anthracite is 1·87 lbs. per KW.-hour, or 2·66 lbs. per car-mile, the units per car-mile having come down to 1·21.

Cylinder oil cost 3¼d. per lb., which is about 2s. 10d. per gallon, while engine oil cost about 2d. per lb.

The average consumption in 1901 was—

Per effective H.P.	0·03 lb.	= 0·09d.
,, KW.-hour	0·048 ,,	= 0·13d.
,, car-mile	0·059 ,,	= 0·177d.

Since the oil has been collected, filtered, and used on the cars, the total consumption has been reduced by 25 per cent.

With coal at 37s. 6d. per ton, the total cost of 1 KW.-hour in Barcelona was 1d. The author reproduces the conclusions of M. Witz as to gas power to the effect that the gas producer efficiency is slightly better than steam boiler efficiency, while the gas engine is far superior to the steam engine, so that the fuel consumption in the smallest plants with gas power is much less per unit than that of the largest plants of steam power even when employing superheat.

The cost of the Barcelona station, including land, power house, car sheds, shops and stores, has reached £21 per kilowatt. The erection of the gas producers, engines, accumulators of 450 ampere-hours capacity, gas holder and shops was £17,480, or £40 per available kilowatt, the total cost per available kilowatt being £61. The station was erected in 1900, a period of high prices, and the present cost of producer gas plant would not exceed £28 or £31 per available kilowatt.

On a small line of 14½ miles known to the author, it cost £8,100 to put up two sets of 250 H.P., or 185 KW. each, with producers, purifiers, holders, dynamos and water mains, or £24·32 per available kilowatt. The prices for steam plant reached £6,600, or £17·8 per available kilowatt, whence it would appear that the economy of gas plant must be sought in its working rather than in first cost, and on this point figures are given showing a cost per kilowatt-hour of 0·8 to 1·0d. for small power stations of 100 to 200 KW. capacity with coal at 12s. 6d. to 16s. 6d. per ton, and of only 0·5 to 0·7 for similar gas stations with coal at 25s. to 33s. per ton. It appears to be the practice of the Continental gas stations to use anthracite at a high price for gas production, and, we believe, it usually is brought from Wales. The same station with coal at 12s. 6d. to 16s. 6d., would run for 0·4d. to 0·6d. per unit—showing the value of a producer that will work well with ordinary coal. If gas power is to become universal, the gas producer will need to be one that can use ordinary coal, and the sooner this is recognised, the better it will be for gas producer makers.

W. H. B.

THE REDUCTION OF ALUMINA BY MEANS OF CARBON.

A recent issue of the *Journal of the Society of Chemical Industry* contained an interesting note by S. A. Tucker and H. R. Moody on "The Reduction of Alumina by Means of Calcium Carbide." The authors first describe an experiment in which a mixture of 100 grammes of alumina, 112 grammes of lime, and 125 grammes of coke was heated in an electric furnace for 10 minutes with a current of 150 amperes at 70 volts. The carbide obtained was in no way peculiar, but along with it were found buttons of metallic aluminium, which on quantitative analysis proved to contain 99 per cent. of aluminium with 1 per cent. of iron and mechanically enclosed carbon. Some 26 other experiments are also mentioned in which the proportions of the various ingredients and the volume and tension of the currents were altered; metallic aluminium being discovered in certain cases but not in all. Messrs. Tucker and Moody sum up the results of their research by asserting that "aluminium oxide is not reduced by carbon to any appreciable extent, even when both are heated to the extremely high temperature of the electric arc. The addition of lime and the necessary excess of carbon forms an alkaline earth carbide, which is in turn decomposed; and being a body exothermic on decomposition it yields up a large number of calories, and thus raises the temperature to such a degree that reduction of the oxide takes place to an appreciable extent. The carbide may be made in separate fusion and added to the alumina, with or without carbon, but the presence of some carbon seems to increase the yield of the metal. The production of the carbide in a separate fusion would, however, be condemned on economic grounds. As regards time, anything over 12 or 15 minutes is prejudicial to good results, and converts the reduced metal to carbide in amounts increasing directly as the excess over the maximum permissible time increases. Aluminium carbide was found to be produced from the metal, and not the reverse. The results obtained favour the use of high amperage and voltage for not more than 15 minutes. The presence of both carbon and a carbide of an alkaline earth is required. Air should be excluded. The amount of alumina should be considerably in excess of the theoretical amount of coke."

In stating that aluminium oxide is not appreciably reduced by carbon even at the temperature of the electric furnace, Messrs. Tucker and Moody would certainly appear to have made too comprehensive an assertion. The reaction between alumina and carbon is so extremely endothermic as to be very difficult of accomplishment; and for years it has been acknowledged to be practically if not theoretically impossible without the assistance of the electric current. Employing the latest and best thermo-chemical data available some six years ago, Dr. Richards has calculated that the lowest temperature at which carbon can reduce alumina is 1,980° C.—a heat sufficiently difficult of attainment in any non-electrical apparatus. So much energy, indeed, is absorbed in the reduction, that even a weak electric furnace fails to determine the reaction; but to the best of our knowledge, no responsible authority has ever denied the feasibility of chemically reducing aluminium oxide by means of carbon granted the production of a high enough temperature. W. Hampe (whose name Messrs. Tucker and Moody incorrectly give as "Hempel") was referring only to such temperatures as can be obtained in combustion furnaces when he asserted the reduction to be impossible on thermo-chemical grounds, and he simply "assumed" that it would not succeed at the "somewhat higher temperature" of the electric arc. Richards, whom the present authors also quote on the same side, in the passage mentioned by them was dealing with chemical or metallurgical processes alone: elsewhere he describes the electric current as an "almighty" reducing agent. As a matter of fact, there is plenty of evidence that carbon will reduce aluminium oxide. Even in the old Cowles furnace, when for experimental purposes no copper was added to the charge, crystalline masses of nearly pure metallic aluminium and yellow crystals, consisting presumably of aluminium carbide, were obtained; but so much metal volatilised, and so much loss was experienced in collecting the reduced aluminium into an ingot, that it was found impracticable to make the process a commercial success for the winning of elemental aluminium. Nevertheless it was possible, if only as a chemical experiment of no pecuniary value, to win elemental aluminium from the Cowles furnace; and that furnace was used merely to produce by electrical agency such an extraordinarily high temperature as to start a chemical reaction which could not otherwise be determined. In practice, copper was always employed in the Cowles process; but, although it no doubt assisted the operation to a small extent by virtue of the heat liberated during its combination with the reduced aluminium in the production of aluminium bronze, the main function of the copper was assuredly a physical one, as it formed a solvent and collecting agent for the aluminium at the moment of liberation from its oxide. Again, more recently Moissan has distinctly reduced alumina with carbon (*Comptes Rendus*, 1894, cxix., 935), obtaining small spheres of metal mixed with condensed crystals of alumina and graphite in his electric furnace with a current of 1,200 amperes at 80 volts or less. He has plainly shown that reduction is simply a question of temperature, *i.e.*, of current density in the furnace. Fused alumina may not be decomposed by carbon, and even the vapours of the two substances may mix without reacting; but given a sufficiently great heat, reduction does occur.

Messrs. Tucker and Moody are clearly right in saying that alumina is more likely to be reduced by calcium carbide than by carbon—this could be foreseen from thermo-chemical grounds, inasmuch as calcium carbide is "exothermic on decomposition;" but their experiments do not justify them in denying the possibility of the other reaction, since all their tests were made under conditions unfavourable to the interaction of aluminium oxide and carbon alone.

Cape Colony.—Two 330-H.P. Westinghouse compound engines are to be sent out for driving and lighting work in the mines of the Indwe Coal and Land Company.

THE EFFECT OF ELECTRIC WAVES ON THE HUMAN BRAIN.*

By D. McINTOSH and J. GRAHAM-WILLMORE.

Under the above title there appeared in the *Electrical World and Engineer* of February 22nd, 1902, an article by Mr. A. Frederick Collins, in which the author gives an account of experiments which show that human brains, as well as those of living and dead animals, are sensitive to Hertzian waves, in that they exhibit the well-known "coherer" effect; and from these results he draws conclusions regarding the effects which electrical storms can have on human beings, supporting his contentions with results which have come under his notice.

These results seemed to us so very interesting, and at the same time the experimental methods seemed so defective—since Mr. Collins, in testing the coherer effect, had used a telephone, an instrument gauged by an organ having much less discriminating sensibility than the eye—that it appeared worth while repeating the work with apparatus which left small possibility of error.

The apparatus for generating the waves was that ordinarily employed, and consisted of an induction coil operated by three accumulators. The secondary terminals were brass balls, about 2 centimetres in diameter, and the spark-gap during the experiment ranged from 2 to 5 centimetres. The terminals were directly connected to two plates made of sheet zinc, having a combined area of 1 square metre.

In order to detect the waves and to test the apparatus before each set of experiments, coherers filled with metallic particles with the usual terminal wires, consisting, in this case, of brass rods 7 ft. long, were employed; and to eliminate effects due to distance,† experiments were made with the coherers, 4, 10 and 25 ft. from the induction coil.

In series with the coherer were placed an accumulator and a Weston millivoltmeter, reading, by aid of its shunt, currents to milliamperes. The resistances of the coherers, which were carefully measured by means of Kohlrausch's apparatus, were in case of the three used, between 30,000 and 45,000 ohms. These resistances changed after the passage of the waves for 10 seconds to 4½, 5 and 5 ohms, respectively.

Since we know the brain to consist of moist material, and the passage of electricity through it to be due to electrolytic conduction, it seemed not out of place to try the effect of Hertzian waves on solutions. For this purpose two solutions were used: one of zinc sulphate between amalgamated zinc electrodes, so as to avoid polarisation currents‡ and enable the resistance to be measured with a Wheatstone bridge; and the other, a normal (0·6 per cent.) solution of sodium chloride between platinum electrodes. The cells containing these solutions were substituted for the coherers and the coil was started.

Although these resistances could be measured to within $\frac{1}{10}$th per cent., the Hertzian waves could not be found to have any effect.

In our experiments on brains, two pieces of apparatus for making contact were employed. The first consisted of two stout platinum plates, platinised to facilitate conductivity measurements, sealed into glass tubes and arranged on a frame so that the distance between them might be varied; the second was made of two platinum wires sealed into glass tubes and kept exactly 1 millimetre apart. The resistances were measured either by the ammeter (with a potential difference of from 2 to 23 volts), or by Kohlrausch's apparatus, the current in either case flowing for only a few seconds.

The following experiments were performed:—

A cat was anæsthetised with ether, an incision made in the median line and the bone cleared off the occipito-frontal aponeurosis. A hole (2 cm. in diameter) was then drilled in the parietal bone not far from the median line. The membranes were then cut away, the surface off the brain swabbed clean and dry, and the electrodes were introduced, at first at a distance of ·75 cm. apart and afterwards 1 mm. apart, so as just to penetrate the grey matter. The coil was then turned on, but absolutely no change in the deflection of the ammeter needle was observed, nor could any change in the resistance be noticed when measured by Kohlrausch's apparatus. The electrodes were then introduced into the subjacent white matter. This also gave a negative result. The electrodes were then pushed downwards and slightly forwards and inwards to a distance of about 3 cm., so as to reach the grey matter of the basal cerebral ganglia. Here again no deflection was observed.

During this experiment the cat was kept fully under the influence of the anæsthetic, *i.e.*, the anæsthetic was pushed to the usual "anæsthetic" or operative stage, as shown by the respirations being normal, the pulse slightly quickened and the corneal reflex abolished. At no time, however, did the cortex fail to respond to the stimulus caused by the make and break of the current.

A fresh human brain, with the meninges practically intact (1161·5 gms. weight), from a woman just recently dead from cancer and absolutely free from contamination with any antiseptic, was the next subject for experimentation. It will be remembered that Mr. Collins affirmed to have obtained the most marked coherer effects with this material, and in view of this hopes were entertained for a refutation of the negative results obtained in the previous experiments. These hopes were, however, speedily shown to be vain, as in no part of the cerebrum, cerebellum or medulla, in spite of the most elaborate precautions, were observed the phenomena so definitely described by Mr. Collins. The dura and arachnoid were dissected off, the cerebral surface carefully dried of cerebro-spinal fluid and the electrodes inserted at a distance of 1 mm. apart to the following portions of the brain:—

1. Cortical grey matter of the ascending frontal gyrus, near its termination.
2. Subjacent white matter, the grey having been previously sliced away in this region.
3 and 4. Cortical grey and subjacent white matter of Broca's convolution.
5 and 6. Cortical grey and subjacent white matter of gyrus angularis.
7 and 8. Cortical grey and subjacent white matter of superior temporal sphenoidal gyrus.
9 and 10. Cortical grey and subjacent white matter of ascending parietal gyrus, at about the level of the centre of the Rolandic fissure.
11. The internal capsule, both of the motor (anterior limb) and sensory (posterior third) portions.
12 and 13. Grey matter of the optic thalamus and caudate nucleus.
14. The striæ acusticæ on the floor of the fourth ventricle.
15 and 16. Cortical grey matter and white matter of the arbor vitæ of the cerebellum.
17. As accurately as possibly, the granular or rust-coloured layer of the cerebellum, which Mr. Collins found the most sensitive of all portions of the encephalon.
18. Various parts of the pons, including most of the nuclei of the cranial nerves situated therein.

A happy coincidence enabled the observers to endeavour to reproduce Mr. Collins' results during a somewhat violent thunderstorm, which broke over Montreal during the noon of April 26th. A pigeon was hastily decapitated—the first animal at hand, since it was impossible to foretell how long the storm would last—the electrodes placed in position in its brain, and the ammeter carefully watched during the entire course of the storm for a deflection of its needle. Unfortunately, negative results were again encountered, as, though several flashes occurred, not the slightest trace of any cohering action in the brain was observed.

It may be objected by Mr. Collins that the brain of a pigeon is so low in the scale of evolution—and his most marked results were with the highest brains — that no reaction could possibly be expected. If, however, a short excursion into the realm of theory be permitted, it might be argued that Mr. Collins explains the indisputable power that various individuals have of predicting the advent of an electrical storm, upon the ground that the brains of these

---

*This article is reprinted from the *Electrical World*. See also article by A. F. Collins in Electrical Review, May 23rd, 1902, p. 845.

†Bose, London *Electrician*, 776, 864, 897. 1901. *Phil. Trans.*, 1910.

‡We might mention here that the astonishment of Mr. Collins in finding difficulty in measuring the resistance of a brain (an electrolyte) by means of a Queen testing set, will not be shared by those who have attempted to measure such resistance with a direct current. The sudden swinging of the galvanometer-needle when an approximate balance was obtained is due, of course, to polarisation currents, and is probably not affected by atmospheric electricity. Such measurement can be made accurately and rapidly by means of an alternating current and telephone. (See Kohlrausch and Holborn: "Leitvermogen der Elektrolyte.")

individuals are specifically affected by the advance guard of Hertzian waves sent out by that storm; that this condition, when the higher psychic centres were alone affected, resulted merely in fear or a vague feeling of uneasiness, but that when the medullary vital centres were affected, it resulted in some pathological condition varying from pain to actual death itself.

It has often been noticed upon the approach of a storm, long before the first flash be seen or the first distant roll of thunder be heard, that birds show unmistakable signs of fear, or of a premonition of evil. They suddenly become hushed, not a note of song is heard, and they all huddle together as if for sympathy or mutual protection. Surely the same agency, whatever it may be, must be at work upon the brains of birds and upon susceptible human beings. If so, it seems reasonable to argue that the brain of a bird should be a singularly fit subject for an experiment of this nature.

A cat was again chosen for the next experiment; it was decided to ascertain whether or not the depressing action of the ether upon the sensorium was responsible for the negative results hitherto obtained. Accordingly, after exposing the brain in the usual manner in the ectosylvian region, the electrodes were inserted and a preliminary trial made, with, as before, a negative result. Upon this occasion Dr. Wesley Mills, Professor of Physiology in the University, kindly lent his presence both as an impartial observer of the phenomena manifested and in the capacity of an expert superintendent of their physiological aspect. The cat was then allowed to recover from the anæsthetic until all reflexes were established and a certain amount of voluntary movement noted.

The grey cortical matter, the white, the internal capsule, and the basal ganglia were then in turn tested, with, as before, absolutely negative results in each case. The bone was then replaced—the cat being then under the influence of more ether—the wound sewn up, dressed, and the cat allowed to recover.

En passant, it may be observed that during this operation the characteristic twitching of the muscles mentioned by Mr. Collins, as occurring only during the emission of the waves, was repeatedly noted. This twitching, as any anæsthetist knows, is by no means uncommon; it occurs either at the commencement of, or more usually during the recovery from anæsthesia, and it seems unnecessary in this case to call in the aid of electricity to explain what is, after all, a purely pharmacological condition.

The various functions of the brain have been regarded as controlled by centres, each of which has its own work and definite status in the economy of the organism. These "centres" are susceptible to the action of drugs, particularly to the depressing action of the alcohol group, to which ether belongs. In each case the highest—or more lately evolved—centres are the first to be influenced, the lowest, the great vital centres of the medulla, the respiratory, cardiac and vaso-motor centres, are among the last. This must necessarily be so, since they are essential to life.

The action then of ether consists in a transient stimulation, followed by a progressive depression and later paralysis of these centres, in a descending order—the highest being the most susceptible are also the last to recover their normal functions.

Voluntary motion of all kinds may be regarded vaguely as the composite result of two main centres, a "stimulating" of which the function is to set the neuro-muscular apparatus in operation, and an "inhibiting" which governs and co-ordinates the movements performed by regulating the nerve-impulses sent out by the former.

Among the highest centres of all are the inhibitory of all kinds, and a condition is easily conceivable in which the centres co-ordinating or inhibiting the action of those muscles, would be inactive, while the lower stimulating centre—either recovering sooner or succumbing later—would have full play. This would cause in the muscles, which it supplied, an inco-ordination of movement, *i.e.*, it would run riot.

This is well shown in the talkative delirium of a patient recovering from ether, in which spasmodic contractions of other muscles are an earlier symptom; the freedom of speech of a man under the influence of alcohol is also another case in point. Moreover, similar twitching—amounting in some instances even to convulsions—is seen in cases where there is an anæmic condition of the brain from any cause, resulting in imperfect nutrition. Mr. Collins seems to have been much impressed, too, by the death of a delicate and nervous child, occurring immediately after a flash of unusual severity, and to regard mere fright as a by no means sufficient cause therefor. Mr. Collins may, or may not, be aware that death from "psychic shock" is by no means an uncommon accident, under conditions which absolutely preclude the very possibility of atmospheric disturbances being the causative agent.

Death in these cases is usually due to a sudden reflex depression of the medullary centres—any kind of sudden mental impression, provided it be of a sufficiently violent nature, proving an effectual initial stimulus. Thus patients often died, in pre-anæsthetic days, immediately upon the first incision, and one case, at least, is on record in which a French surgeon (Desault*) "drew his finger-nail over the perineum of a patient to mark the line of incision, when the patient suddenly gave a cry and was dead." Cases of this nature tend most strongly to the conclusion that fright, and fright alone, can cause death.

In conclusion, the theory advanced by Mr. Collins as regards the peculiar nervous phenomena evidenced by various people, especially those of a neurasthenic disposition, during an electrical storm, is undoubtedly most suggestive; but the present experimental evidence seems to show it to be far too speculative for it to be regarded even in the light of a working hypothesis.

It only remains for the writers to express their sincere and heart-felt thanks to Prof. Rutherford and Prof. Wesley Mills for the loan of apparatus and much kindly interest and encouragement.

* Sollmon. Text-book of Pharmacology.

L.C.C. ELECTRIC TRAMWAYS.

ALTHOUGH little is heard about it, the work of reconstructing the tramways between Westminster and Tooting is making rapid progress. About six miles of track have been completed, and Messrs. J. G. White & Co., who are responsible for the whole of the work, are advancing at the rate of 800 ft. of track per day. It is worthy of note that the work is left in a completely finished state; not only are the insulators put in place, but the working conductors themselves are permanently fixed in position as the track is completed.

Only one of the tracks is dealt with at a time, the other being left intact for the use of the horse cars until the adjoining conduit track is finished, after which the cars are diverted to the latter, and the second track is reconstructed. Until recently the whole of the traffic was carried on with the single track and temporary turn-outs; but so much difficulty and delay was incurred with this system that the contractors have cut the Gordian knot by laying a temporary track alongside of the whole length of track that is "up," so as to carry on the traffic without interruption. The temporary track consists of flat rails laid on the surface of the roadway.

Contrary to expectations, the trouble with pipes in the roadway has so far been comparatively unimportant, doubtless in part because the work was begun at the suburban end of the route; happily, trial excavations at points nearer Westminster indicate that even there, less difficulty will be met with than was at first anticipated. Thanks to the willing co-operation of the local authorities with Messrs. J. G. White & Co., great expense has in some cases been saved by accommodating the track to the existing conditions. For instance, three very large water mains were found occupying a considerable space in the roadway, between the southern terminus at Tooting and Clapham Common; by slightly diverting the course of the tracks at this part of the route, it was found possible to entirely obviate removal of the pipes.

It will have been noticed in our last issue that the L.C.C. has awarded to Messrs. J. G. White & Co. an additional contract for about 4 miles of track, comprising three short

sections, the reconstruction of which the Highways Committee regards as urgent. These contracts were settled on the same terms as previously existing contracts, without waiting for fresh tenders. The most interesting section is that which connects with the Brixton cable system at Kennington; the latter will be converted as soon as practicable, but in the meantime the cable will be retained, and the cars will be equipped with both ploughs and grips. We shall fully illustrate the plans for this arrangement when they are completed.

The feeder cables form the subject of a separate contract with the same firm; they are to be carried in ducts under the footpath at the side of the road, and the work of laying them is about to commence.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

10,940. "Improvements connected with incandescent electric lamps." J. Swinburne. Dated June 16th, 1900. Relates to incandescent lamps.—Non-oxidisable heaters for starting refractory incandescence bodies are made from a conducting material such as graphite, carbides, silicides, silicon, tungsten (prepared by electrolysis of a fused tungstate), or other metal, in powder, mixed with non-conducting material such as kaolin and felspar, or clay prepared for making china. The mixture is kneaded, squirted into thin rods or spirals, dried, and baked. The temperature may be high enough to vitrify the material, or the rods can be dipped in boracic acid or other glazing material in water and fired. 1 claim.

10,974. "Improvements in electric accumulator electrodes and plates." A. Ricks. Dated June 16th, 1900. An electrode is made up of a thin plate of vulcanite, aluminium, or other material, to which is applied a layer of active material in a hard granulated condition, the attachment being effected by an adhesive, or in other ways. This layer serves as the means of attachment to the bulk of the active material, which is applied to it in the usual way. The connections consist of thin perforated strips or plates of lead, which are simply laid against the face of the active material, and pressed against it by springs of rubber or other insulating material, the object being to avoid the inconveniences resulting from the soldering of the connections. 5 claims.

10,977. "Improvements in colouring or decorating brass, copper, and other metallic objects, encaustic and other tiles, or china or porcelain wares." D. Sinclair. Dated June 16th, 1900. Coloured surfaces are produced electrolytically on metal by making this the anode in an alkaline lead or lead and copper solution. The process is applicable to brass, copper, and other metal articles, or to encaustic or other tiles, china, porcelain, stone articles, or other fictile ware, previously faced with metal by electro-depositing copper, fritting on foil, or heating in vapour of nickel carconyl. 3 claims.

10,999. "An improved automatic fire alarm apparatus." H. G. Lyngaas. Dated June 16th, 1900. Relates to an arrangement for closing an electric bell circuit when the temperature exceeds a certain limit. A plate is cemented by wax to a disc of wire gauze fixed over an aperture. When the temperature is sufficient to melt the wax, the plate is pulled up by the spiral spring, and thereby permits two contact-pieces to meet and close the circuit of an electric alarm bell. 2 claims.

11,003. "Improvements in electric railways on the third-rail or surface contact system." H. H. Lake. (Communicated.) Dated June 16th, 1900. Relates to electric railways and tramways on the sectional conductor or third-rail system. 24 claims.

11,008. "Improvements in secondary electric batteries." H. H. Lake. Dated June 16th, 1900. The electrodes are each made up of a frame which consists of four bars, which may be made of non-conducting material, preferably cedar, and are joined together as shown. On this frame, but separated from it by a strip of wood, is placed a bar of lead provided with parallel rods, which pass through holes in the wood strips and through another strip of wood, and their lower ends are then clinched into heads to hold the whole in place. Two perforated plates of celluloid, or the like, are slid in to grooves formed in the four bars, one plate lying on each side of the rods. The celluloid plates serve to hold the active material in place. 8 claims.

11,011. "Improvements in electrical switches and cut-outs for heavy currents and high potentials." H. W. Clothier. Dated June 18th, 1900. The contacts are formed of metal blades or laminæ, which are arranged in parallel when the circuit is closed, but are in series at the moment of breaking. 3 claims.

11,022. "An electrical apparatus for adjusting tramrail joints." J. E. Macaulay. Dated June 16th, 1900. Points and switches operated from the tramcars. The point tongue is thrown by a pivotted lever with trough-shaped end lying below the groove of the rail and actuated by an L-shaped bar on the vehicle. This bar is raised and lowered by a spring and electro-magnet, and it is turned to the right or left by an arm engaging with springs, which are compressed by the cores of the magnets. The magnets are excited in that order by contacts on a shaft operated by the driver, which complete the circuit through the conductors after the cam-operated contact has been lifted to connect the supply. The common return is broken by the arm which turns the L-bar when the latter has thrown the tongue. The arm and magnets are carried from the axle of the vehicle. 8 claims.

11,026. "Improvements in cord-grips for electric light fittings." A. P. Lundberg and S. C. Lundberg. Dated June 18th, 1900. A cord-grip consists of an internally-screwed part with two longitudinal grooves to receive the two conductors separately, and a plug or nut is screwed thereon and holds the conductors in the grooves. The screwed part may project from a flat surface, against which the conductors may be clamped by the plug or nut. 8 claims.

11,056. "Improvements in the manufacture of lead-covered cables." H. Cassirer. Dated June 18th, 1900. Lead sheathing for conductors contains a small portion, about ½ per cent., of the antimony to increase the hardness and reduce the specific gravity. 1 claim.

11,101. "Improvements relating to the magnetic properties of iron and steel." F. W. le Tall. (Communicated). Dated June 19th, 1900. The permeabilities of round rods of magnetic material, such as iron, or steel are measured by an instrument, supplied with measured electric currents. A specimen is clamped on one end of an iron yoke, the other end of which is provided with a sliding iron piece movable by a micrometer screw. A split iron disc is clamped flush with the end of the specimen of a screw, an air-gap and piece are surrounded by two coils provided with a pointer, is pivoted in a case to indicate the existence of magnetic leakage from the disc. Such leakage is stopped by adjusting the length of the air-gap by the micrometer screw; the magnetic fluxes through the air-gap and specimen are then the same, and the permeability of the specimen is obtained from the micrometer reading and other data. The needle may be magnetised and controlled by a magnet to render it more sensitive. Other means for detecting the magnetic leakage may be used. The Provisional Specification mentioned the measurement of the current by a meter marked to directly indicate the magnetising force produced. It also refers to use of the instrument for measuring magnetic hysteresis, and to modifications in which the air-gap is concentric with the specimen, or a second specimen forms the return path. 3 claims.

11,120. "Improvements in patterns or designs for electrically regulating the operation of card-punching machines, embroidering machines and jacquard and other looms." E. Edwards. Dated June 19th, 1900. Patterns or designs for electrically regulating the operation of card-punching machines, embroidery machines, and jacquard and other looms are formed of a series of insulated portions each of which is included in a separate circuit. 11 claims.

11,187. "Improvements in ploughs for conduit electric railway cars." J. E. Gottsberger. (Communicated.) Dated June 16th, 1900. Relates to electric railways and tramways on the conduit system. The ploughs are so provided with two sets of shoes so that the lower set can be dropped, and the upper set brought into action when required. 11 claims.

11,190. "Improvements in switches for high-tension electric currents." Siemens Bros. & Co. Dated June 20th, 1900. Relates to switches for high-potential currents in which the arc is extinguished by drawing it within a tube of insulating material. The figure shows a double-pole switch in which the contacts are connected by a rod. The insulating tube is fitted with a metal ring to assist in cooling or preventing overheating of the tube. 1 claim.

11,206. "Improvements in electric switches and like apparatus for making and breaking electric circuits." G. W. Partridge and G. K. B. Elphinstone. Dated June 20th, 1900. The switch is held in its closed position by a catch, which is released by electro-magnetic means should an abnormal current flow. The switch arm is pivotted and carries two pawls, one having a tail piece adapted to engage a stop and hold the switch closed against the action of a spring both or of a weight. The other pawl is normally held against a stop by a spring and carries a pin arranged in the path of an arm connected to the handle. A solenoid is carried by the switch arm, and carries the current when the circuit is closed. The core carries a rod passing between the pawls, and is fitted with a collar adapted to strike against the projecting parts of the pawls. With an abnormal current, the core is raised, and the tail detached from the stop. The switch cannot be held closed by the handle, as the pin will be held clear of the arm. To open the switch by hand, the handle is fitted with a tail piece, adapted to operate the pawls when the handle is moved down. 4 claims.

11,207. "Improvements in or relating to the distribution of electricity." L. Andrews. Dated June 20th, 1900. Relates to systems of distribution in which step-down transformers at sub-stations supply the distributing network. Means are provided for cutting out the transformers at periods of light load, the low tension current being supplied direct from the central station. In the preferred arrangement, the switches are operated by hand for cutting out the transformers, but are closed automatically when the high tension current is supplied. 5 claims.

11,208. "Improvements in electrical signalling apparatus." F. J. Warden-Stevens. Dated June 20th, 1900. Relates to the type of signalling apparatus in which the transmitter or the receiver comprises a magnet, a soft iron body, and a coil, or coils, so arranged that by relative movement of the parts an alternating current is generated in the coil, and may be employed for ringing bells, &c. The object of the invention is to increase the rate of change of magnetic flux through the coil, and thereby render the apparatus more powerful. 6 claims.

11,217. "Improvements in the method and material for covering electric cables, conductors, or wires with insulating material." G. E. Heyl-Dia. Dated June 20th, 1900. Conductors are insulated by applying to the wires one or more layers of composite material consisting of sheets of vulcanised rubber or other suitable insulating material, such as vulcanising bitumen rubber compositions or substitutes, paper, tape, &c., coated on one side with pure—*i.e.*, unvulcanised—rubber, whether pigmented or not. This material may be used in the method of coating described in Specification Nos. 8,289 and 8,290, A.D. 1900. 3 claims.

11,260. "Improvements in electric accumulators and in electrodes therefor." A. Tribolhorn. Dated June 21st, 1900. Relates to bi-polar plates in which the opposite sides of the plates are of opposite polarity. The invention consists partly in providing a layer of an impervious solution or material, such as caoutchouc, in the middle of the active material, to oppose the passage of the ions. The two surfaces of the active material are in electrical contact by means of strips of lead, and the whole is held in place by a light frame of glass or ebonite provided with internal grooves of the shape shown. A rubber ring serves to hold the plates in place in the cell. 4 claims.

11,263. "Improvements in or relating to electric lamps and fittings therefor." H. Hirst. Dated June 21st, 1900. Supporting lamps on posts for street lighting or other purposes. The lamps are carried by reflectors on a cover, which can be turned up about a hinge pin on a supporting-arm to afford access to the interior of the globe. The globe is carried by a ring on pivots between the supporting arms. The cover may be fastened down by a screw or otherwise. The conducting wires are passed through the arm, round the hinge pin and through a tube. 1 claim.

11,264. "Improvements in or relating to switchboards for electric distribution." H. Hirst. Dated June 21st, 1900. A switchboard is built up of a number of separable bases or elements which are connected to the bus-bars. 2 claims.

11,272. "Improved means of, and apparatus for, preventing the premature starting of electric motors or the like used in connection with electric lifts." J. Hofbauer. Dated June 21st, 1900. Relates to (1) apparatus for preventing the starting of the motor so long as a well door is open, and (2) means for gradually starting the motor as the door is shut. Each well door carries an arm through which, and a contact, the motor circuit is completed when all the doors are closed. When any one door is open, the circuit is broken. All the doors being closed except one, the closing of this completes the circuit in succession through the contacts, thus gradually cutting out the resistances and starting the motor. 1 claim.

11,287. "Improvements in or relating to conduits for electric conductors." F. Jones. Dated June 21st, 1900. Relates to the class of conduits described in Specification No. 12,953, A.D. 1899, and consists in forming the joints with sockets other than of parts of circles or ellipses, and having the upper surface open for a less extent than the maximum width. 5 claims.

11,340. "Improvements in and connected with electric clocks." M. Fischer. Dated June 22, 1900. Relates to electric clocks; synchronising apparatus and escapements. 9 claims.

11,344. "Improvements in the manufacture of filaments for incandescent electric lamps." W. L. Voelker. Dated June 22nd, 1900. Relates to incandescent lamps. Filaments are made of carbides such as those of uranium, titanium, zirconium, and beryllium, singly or mixed. In one method a fibrous cotton thread or a squirted cellulose thread is made chemically clean, and soaked in a solution of chloride, acetate, cyanide, or other readily-decomposable salt of the metal; titanium-triethylphenyl or titanium chloride dissolved in alcohol and benzene is recommended. The thread is dried, and ammoniated if a salt of a mineral acid has been used. It is wound in layers on a paper cylinder, with rice paper between the layers, and dried for 12 hours at temperatures rising to 400° F. It is then packed with powdered carbon and carbide in a closed crucible, made of annular form to equalise the heating, the crucible being placed on an open stand to admit hot gas to its central opening; the crucible is gradually heated to intense white heat, and allowed to cool. The carbonised thread is next drawn through an electric arc to convert it into carbide, nearly at the temperature of fusion. The arc is formed in an atmosphere of hydrogen, or vapour of a hydro-carbon, or of the metal forming the carbide. In modified methods a carbon filament may be first passed through an arc to convert it into graphite, and is passed through an arc in a metallic atmosphere to convert it into carbide. The finished filament is cut and bent into horseshoe form, and mounted in bulbs. The invention also describes an arc furnace for the above-described process. 5 claims.

11,358. "Improvements in or connected with electric batteries. H. U. Wellington and T. V. Sherrin. Dated June 22nd, 1900. The invention relates to an electrode, and consists of a helically-wound strip of lead, in which are a number of holes, and around, and in which the active material is packed, the whole being covered by a perforated tube of ebonite or the like. The tube may be split as shown, or may have overlapping edges, or may be a complete tube with end rings to keep it in place. 1 claim.